CENTURY OF PROGRESS AND E.E.I. CONVENTION NUMBER

ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

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OKONITE moves on with the WORLD

Exhibit of The Okonite Company, World's Fair, Chicago, 1893

Picture reprinted from "Electrical World" August 19, 1893

Founded in 1878, Okonite has continuously *specialized* in the manufacture of insulated wires and cables.

Progressive now, as it was during the last World's Fair in Chicago, The Okonite Company keeps moving to meet the new trends.

Now, as then, the name Okonite is a world-wide symbol for quality—an honest, absolute quality which assures long and satisfactory performance.

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OKONITE QUALITY CANNOT BE WRITTEN INTO A SPECIFICATION

ELECTRICAL WORLD

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May 27, 1933

International

1933 Chicago Century of Progress Exposition as seen from the air

Century of Progress Opened This Week

CHICAGO'S $25,000,000 investment in international industrial display, the Century of Progress Exposition, opened this week with elaborate ceremonies. Postmaster-General James A. Farley, as personal representative of President Roosevelt, participated in ceremonies beginning early in the forenoon and culminating in the turning on of the exposition lights in the evening with 40-year-old light impulses from the star Arcturus, amplified by photoelectric cells and relays.

Electricity is well represented here, just as it was in the World's Fair of 1893. The electrical industry, in addition to the many exhibits of manufacturers, is participating in a great display designated as Electricity at Work, designed to bring to visitors the story of the multitudinous tasks and services which that form of energy can and does provide. Exposition lighting is upon a huge, novel and unprecedented scale. Gaseous discharge tubing is widely used.

June 5-8, in Chicago, the Edison Electric Institute will hold its first convention. As the organization which replaces the National Electric Light Association, its deliberations are of special interest to the industry. This issue of ELECTRICAL WORLD is dedicated not only to the forthcoming E.E.I. convention, but to the story of the whole Century of Progress Exposition.

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Rocky Mountain Association Moves for Trade Revival

United under the newly formed Rocky Mountain Electrical Association, the entire electrical industry of Colorado, New Mexico and Wyoming has launched a business-building and load-recovery program which promises to bring notable results. This is said to be the most comprehensive single activity ever undertaken in this area by utilities and related enterprises. It is hoped that it will have a perceptible effect upon business conditions in general in that territory.

The project contemplates a series of novel electrical displays, lighting and merchandising expositions and educational exhibits, the latter for the purpose of acquainting the public with some of the little-understood problems, arts and mechanics involved in rendering electric and telephone utility service. The movement, which will culminate with "Electrical Week," early in October, coincident with the anniversary of Thomas A. Edison's perfection of the incandescent lamp, will extend to the small, as well as the larger, centers of population. Public officials, the press and various business, civic and trades groups will actively participate, so keen is the realization of the value of the activity said to be. Numerous spectacular events will serve to enlist public attention and interest.

Industry groups co-operate

In accordance with its established joint-merchandising policies, the association will encourage hardware, furniture and radio dealers, dry goods stores and others handling electrical appliances to join in the many local activities, as has been done so successfully each Christmas season. Newspaper, radio and other advertising media will be employed in the drive to recapture lost

load and to build new business, capitalizing on and stimulating the public's awakening desire and ability to buy electrical merchandise.

Business enterprises and professions heretofore not identified with the electrical industry will co-operate fully.

Denver, the chief city in the tri-state area, with the aid of the Electrical League of Colorado, already has its program well under way. Other cities and towns in the three states will join.

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Electrical Manufacturers to Co-operate in Industry Stabilization

Proposed legislation discussed
N.E.M.A. board of governors to act

CHIEF topic for discussion at the Hot Springs meeting of the National Electrical Manufacturers' Association this week was the proposed legislation for the regulation of industry. The Wagner and other bills were explained and discussed and a formal vote was recorded giving the board of governors power to act when proposed legislation becomes law.

At the opening session Gerard Swope reviewed the recent economic changes and legislative proposals. Starting with the Black bill, the Wagner bill represents a reconciliation of conflicting interests and ideas and promises to become a law. Mr. Swope pointed out that if the Wagner bill becomes law the things prescribed will have to be done. It will be the federal administrator that will give the decision as to what the trade associations become and as to what they will do. He stated that some 50 industries had started to work on codes of ethics and trade practices that are to be authorized in the bill. He pointed out that the main purpose of the Wagner bill was to put people to work. If it is necessary to increase prices to do this, then this will be done. In looking at the problems involved industry should act in a wholehearted and broad-minded endeavor to accomplish the purpose of the bill. He stated that it was necessary to be courageous and to go forward on an uncharted sea.

In his address, President J. S. Tritle pointed out that N.E.M.A. had no stigma attached to its past record and always had been a constructive force in industry. However, he stated today there was more general public confidence in the government than in industry and that business must act lest the government enforces rules that may be impracticable. Much of the proposed legislation is emergency action to aid employment by reviving industry. The bills proposed have awakened industry so that it can and must act, and the concern of industry is practical ways to initiate increased business and thus aid employment. Some of the fundamental problems deal with prices, combat overproduction, and involve fair wages and supervision to prevent any perversion of the powers granted for selfish interest.

To arrive at a factual basis for determining prices it will be necessary sooner or later to secure cost data. By the use of proper accounting systems to maintain prices and fair practices there must be power to discipline recalcitrant members. Control of overproduction involves many problems and may even require budgets or allocations of business based upon past operations and future predictions. The problems are so complex and difficult that executives must have the power to institute actions without approval in advance. In the opinion of Mr. Tritle this movement to stabilize employment and business is not a temporary or emergency incident. It will continue when once started and must be shaped with the future in mind. The government will always be in the business picture in the future and the trade associations will have to increase in competency and power to carry out the purposes of the government. He also stated that the primary purpose of the legislation was to increase employment and stated that N.E.M.A. had an opportunity to perform an outstanding public service as well as to stabilize and improve the business status of its individual members.

At the meeting Monday evening F. E. Neagle discussed the proposed legislation in its legal aspects. He stated that the premise was a partnership between government and business. The government proposes to abolish the anti-trust laws and to work out a partnership with industry that will increase employment and stabilize industry. The Wagner bill is very general and does not say what may or may not be done, but its vagueness indicates that the government will regulate industry if industry fails to act for itself under governmental supervision. The law proposes compulsory co-operation and gives the authority of the government to order done many things that industry had said it wanted done. In the opinion of Mr. Neagle, industry must act under the proposed law or the government will act.

Industry groups must act

Under the proposed law industry should state what it wishes to do and then find out what the federal administrator will permit it to do and what he will require it to do and take action that is thus approved and formulated. In this legislation industry gives up some things and gains some things. The government essentially becomes a dictator of industry, but it may largely delegate its authority to the trade associations to enforce the law. Thus N.E.M.A. should become the power in the electrical manufacturing industry to set the standards and enforce the law. But the authority thus exercised must be in the public interest and must have the scrutiny and approval of the government.

General business conditions affecting engineering equipment were discussed by C. L. Collens. Overplant capacity and limited buying were the major problems encountered, but the recent upward trend in business and the added domestic and other load added to utility lines during the depression gave promise of better business in the future. Sales costs have increased greatly during the depression and some companies have entered into new fields of manufacture or marketing in an endeavor to do business. It will take from two to two and one-half times the present business volume to enable industry to have a black balance sheet.

Business conditions in the supply industry were discussed by C. E. Wilson, who cited practices and conditions that could and should be improved. In his discussion of the appliance business A. G. Kimball stressed the advantages that accrued to the industry from utility merchandising and regretted precipitate withdrawal of utilities from merchandising. He also advocated a more careful delineation and analysis of appliance distribution to fix the positions of the manufacturer, wholesaler and dealer more definitely.

N.E.M.A. board of governors authorized to proceed

At the final meeting on Tuesday evening the following resolution was adopted:

Whereas the worldwise depression and resultant economic crisis have stimulated to an unprecedented degree the thought of the country toward ways and means of stabilizing industry, and thus, in a measure, protecting labor, capital, management and the general public against the suffering and destruction of values that go hand in hand with economic collapse; and

Whereas there is today a wide and growing feeling that regulation of industry, either directly by government agencies or through voluntary trade associations, supervised by the government, may be necessary to cure and prevent recurrence of our economic ills; and

Whereas legislation seems imminent providing for the regulation of industry in order to relieve unemployment, create purchasing power, improve commerce and provide for the welfare of employees and the general public; and

Whereas, believing that the welfare of all concerned will be more efficiently and

economically served by the regulation of industry through an association of its members, and that the National Electrical Manufacturers Association should be prepared to act promptly and effectively to this end as soon as it may lawfully do so; therefore, be it

RESOLVED, that the board of governors of the National Electrical Manufacturers Association be and it hereby is authorized to do and perform any and all things that may be permitted or required by the provisions of the national industrial recovery act or any other law having similar purposes that may be enacted by the Congress.

Swope plan before members for consideration

Sponsored by Gerard Swope, president of the General Electric Company, the board of governors voted to submit to the members of N.E.M.A. a comprehensive project for social insurance involving life, disability and unemployment insurance and old-age pensions. Linked with this are proposals for a 30-hour week and a minimum wage.

Under the plan suggested the failure of any member company of N.E.M.A. to comply with the rules and limitations promulgated by the administrative body would be "cause for expulsion and the declaration that the former member has been guilty of unfair method of competition."

Trade Volumes Rise; Prices Weaken

Apparently outstepping the influence of Damoclean inflation the natural recuperative powers of American business are carrying it into new levels of encouraging activity. No longer is manufacturer or dealer optimism bearing the major burden. The consumer is buying. Retail merchandise sales show it. Perhaps, though it is a faint hope, the surgeons will not be called for after all.

Energy production continues unseasonally to swing upward, indicating that industry is using more power. Bituminous coal output has risen to 20 per cent above the corresponding week of last year and 5 per cent above the preceding week of this. Steel operations are reported at nearly 40 per cent of capacity. Orders for softwood lumber are 54 per cent over last year; hard-wood orders have nearly doubled. Cotton shipments to domestic mills are at 160 per cent of the 1919-1931 average. Car loadings hold their own with little change. Truck shipment of merchandise is said to have increased 25 to 50 per cent. General indexes of volumes of trade stand at new highs for the period.

Prices, however, have suffered a moderate reaction. Since the foresworn objective of the administration is to raise them far above today's levels and beyond anything that reasonable resumptions of trade are likely to induce, it is in this sphere that the most significant happenings are to be looked for. To support higher price levels drastic actions may be needed. Open market purchases of government bonds by Federal Reserve banks were said to be resumed this week in order to bolster flagging speculative interest.

Muscle Shoals Misuse Charged Against Utilities

No sooner had President Roosevelt affixed his signature to the Norris-Hill Tennessee Valley law than political opportunism launched a vague and sensational story against the private utilities which have, under contract, used Muscle Shoals energy for the past few years. None-too-subtle charges of damaged government-owned equipment and evaded energy payments without sufficiently tangible backing to indicate their alleged basis shrieked in the newspaper headlines. The companies involved, Alabama Power and Tennessee Power, are awaiting an early investigation and disclosure of the specific charges before commenting upon them other than to deny that any breach of contract has been involved.

Secretary Ickes has announced the case to be in the hands of the Department of Justice and also that such action was taken as the result of a report made upon investigation by Louis R. Glavis of the Department of the Interior.

Both the army engineers, in charge of operations at Muscle Shoals, and the utility men deny that any irregularity or damage is involved. A conflict between army men and Department of the Interior personnel has been rumored.

Presidents T. W. Martin and J. C. Guild of the Alabama Power and Tennessee Valley Power companies wired Mr. Roosevelt, in part: "We respectfully request you to instruct those who are making the investigation for you to proceed at once and make it public, thorough and complete in order that the officials of the Alabama Power Company and the Tennessee Electric Power Company may be able to show at the earliest possible date the recklessly false and untrue nature of the charges quoted in the newspapers."

Morgan to head authority

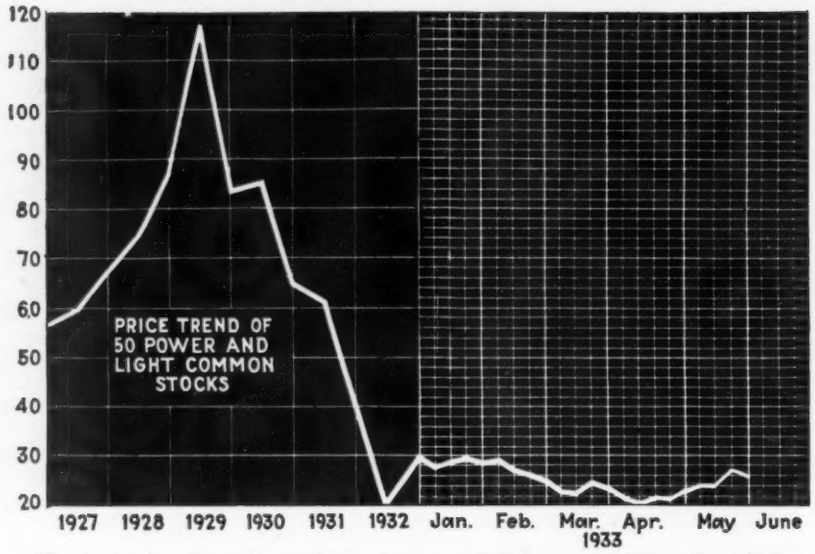
Arthur E. Morgan, president of Antioch College, planner of more than 70 conservation and flood control works, in charge of a $8,000,000 reclamation project in Arkansas, of Miami River flood control in Ohio, and supervising engineer in government drainage investigations of 1907-1909, has been appointed chairman of the newly created Tennessee Valley Power Authority.

Roosevelt Signs the Muscle Shoals Bill

Wide World

Surrounded by the faithful, both Senatorial and Representative, whose varied expressions ranged from unknowing pleasure, anticipation and grave doubt to triumphant complacency, President Roosevelt signed the Muscle Shoals bill late last week. History in the making and mischief at the end

Little Change in Stock Prices



Though the general market swung upward in a mid-week rally, electric utility stocks lagged somewhat. "Electrical World" average this week 26.2, last week 26.6.

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Middle West Bankruptcy Averted by Agreement

Amicable settlement has ended protracted dispute between noteholders of the Middle West Utilities Company and bankers over claims of the banks to certain collateral pledged by the company in the four-month period prior to the appointment of receivers, thus definitely removing the threat of bankruptcy which has hung for several months over this Insull holding company. Under the terms of the agreement between the bankers, representatives of the noteholders and the general creditors, contemplating eventual reorganization, Chicago banks have released the company from obligations totaling $7,000,000 and have agreed to return to the company one-third of the securities they received as collateral for loans in the period before receivership.

In return for these concessions the protective committee, representing the holders of the $40,000,000 of gold notes, has acknowledged the validity of all other pledges to banks, whether they were made directly by the company or through other organizations which had borrowed the securities from Middle West. Early this week Federal Judge James H. Wilkerson continued until October 2 a motion for examination of officials, this action forecasting the abandonment of the bankruptcy suit.

Features of agreement

Charles S. Dewey, chairman of the noteholders' protective committee, summed up the essential features of the agreement as follows: (1) the banks release Middle West entirely from its assumption of liability of loans to Hill Joiner & Company, totaling $2,907,681; (2) the banks cause Middle West to be relieved entirely from other notes totaling $4,000,625. These notes are to be canceled and returned to Middle West. Middle West is, therefore, relieved of obligations totaling $6,908,306. This will leave the banks with secured obligations totaling $11,735,763 after the application of deposits of moneys of Middle West on deposit on the date of receivership; (3) Middle West Utilities Corporation and Middle West Securities Company, two subsidiaries of Middle West Utilities, are relieved of claims against them totaling $230,000; (4) Middle West obtains an adjustment of interest paid to the banks and Halsey, Stuart & Company, by which the rate of future interest is reduced to 2¾ per cent, with an option to the receivers to cease paying interest if the pledged collaterad does not earn it. Middle West also receives from the banks a cash credit totaling $119,129 to be applied to the payment of interest in the future; (5) the banks return to the receivers of Middle West one-third of the net collateral which they received from Middle West within the four months prior to filing of the petition in bankruptcy; (6) Halsey, Stuart & Company returns to the receivers of Middle West one-half of the pledged collateral received in the four-month period; (7) the validity of all pledges to the banks and Halsey, Stuart & Company of remaining securities is acknowledged, whether such securities were pledged for the account of Middle West or others who borrowed the securities from Middle West, and the validity of the A. B. Leach & Company and the Hill Joiner & Company transactions between Middle West and the banks is also acknowledged.

Chicago District Electric sued

Trustee in bankruptcy for Corporation Securities Company filed suit this week in Superior Court of Cook County to recover $756,000 from the Chicago District Electric Generating Corporation, a subsidiary of Commonwealth Edison Company. The bill alleges that Corporation Securities Company while insolvent paid the Edison unit a larger proportion of amounts due it than other creditors will receive.

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With the Legislators

CALIFORNIA—Utilities won a victory when a measure giving the Railroad Commission power to examine the books and accounts of holding companies and other subsidiary organizations of utilities when such organizations own more than 10 per cent of the stock of the utility with which they are affiliated was defeated in the Assembly.

MASSACHUSETTS—Without a record vote the Senate last week referred to the next annual session the bill to subject securities of public utility holding companies to provisions of the so-called blue sky law. Under present conditions when securities are listed on the Boston Exchange they are exempt from provisions of the blue sky law. The Senate concurred with the House in accepting the adverse report, "reference to the next session," from the power and light committee on the bill that cities and towns be authorized to establish municipal lighting plants without acquiring existing plants (ELECTRICAL WORLD, May 20, page 632).

NEW JERSEY—Copy of a bill prepared by Samuel Morris, attorney, designed to facilitate the municipal operation of utility plants has been sent to Governor Moore. The bill provides that publicly owned utilities be financed by their own revenues and not by placing additional burden on taxpayers. It provides also that a petition by 5 per cent of the voters be sufficient to require that a particularly named engineer make a preliminary survey and a vote of the people to create a municipal utility authority to construct a plant pursuant to the report. The measure stipulates that surplus revenues be paid to the municipality to relieve the tax burden.

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New York Metal Prices

	May 16, 1933 Cents per Pound	May 23, 1933 Cents per Pound
Copper, electrolytic	7.00	7.00
Lead, Am. S. & R. price	3.65	3.65
Antimony	6.25	6.25
Nickel ingot	35.00	35.00
Zinc, spot	4.10	4.10
Tin, Straits	35.625	35.50
Aluminum, 99 per cent.	23.30	23.30

Electrical Manufacturers Report Industrial Pick-up

Further signs of more active days in the electrical industry continue to appear. Manufacturers report increased activities. Wage increases are in evidence.

WESTINGHOUSE—Chairman Robertson, having visited company's East Springfield works, states: "I find them operating at an over-all capacity of 65 per cent and those departments devoted to the manufacture of refrigerators at 100 per cent; 2,500 employees are working full time."

COPELAND REFRIGERATOR—Has granted 5 to 10 per cent increase in wages to all factory workers on the hourly rate. On full-time basis six days a week. All former workers recalled.

SPARKS-WITHINGTON — Refrigerator plant working six days a week with considerable overtime.

MAYTAG—Washer shipments during April totaled more than in any one month during 1932 and exceeded the figures of seven months of 1931.

GENERAL ELECTRIC SUPPLY—Conditions in the southern territory are on an upward trend, according to President John L. Buchanan. Instead of the seasonal decline that is usually experienced after January, the company's business has increased each month.

KELVINATOR—Had in April the largest sales for any one month in its history.

SERVEL—Has on hand unfilled orders for 5,000 units and is increasing its production. The company feels a trend in demand toward larger units, on which profit is more substantial.

EUREKA VACUUM CLEANER—Production is now on five-full-day-a-week basis.

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Canadian Output Reported for 1933 First Quarter

Quebec was the only economic area in Canada to report an increase in power production during the first quarter of 1933 as compared with the first three months of 1932, according to figures compiled by the Dominion Bureau of Statistics on central electric station output. For the January-March period of 1933 central stations reported a production of 4,067,252,000 kw.-hr. This compares with 4,127,747,000 kw.-hr. for the initial quarter last year. The decrease in output is accounted for by declines in the British Columbia, Prairie Provinces, Ontario and Maritime areas. Quebec with a production of 2,191,547,000 kw.-hr. this year shows an increase of roughly 78,000,000 over the first three months of 1932.

British Columbia stations had an output in the first quarter of 295,596,000 kw.-hr., or about 10,500,000 less than a year ago. In the Prairie Provinces production dropped from 356,292,000 kw.-hr. in 1932 to 328,199,000 this year. Ontario's stations had an output of 992,814,000 kw.-hr., roughly 132,000,000 less than last year. The Maritimes also report a falling off in production, with an output of 118,142,000 kw.-hr., down from 139,894,000.

Export business does not show any improvement, deliveries for the first three months of 1933 totaling 139,802,000 kw.-hr., as against 169,603,000 for the corresponding period a year ago.

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British April Output Off; Year to Date Shows Gains

For the first time in several years energy production in Great Britain, as indicated by the official figures of the British Electricity Commission, shows a decrease as compared with the corresponding month of the previous year. April production, 952,000,000 kw.-hr., was 3.6 per cent below the revised figure of 988,000,000 kw.-hr. for last year.

The first four months' figures for 1933 indicate, however, that so far this year output has been up by 5.1 per cent. To the end of April 4,599,000,000 kw.-hr. was generated, 4,374,000,000 in 1932.

Major New Construction This Week

Roaring Fork Electric Light & Power Company, Aspen, Colo., plans 21-mile transmission line. Estimated cost $35,000.

Washington (Pa.) Brewing Company to spend $100,000 for expansion.

August Wagner & Sons, Chillicothe, Ohio, plan complete brewery electrification. Cost over $100,000.

State Industrial Commission, Bismarck, N. D., will purchase complete equipment for new light and power plant at State Penitentiary.

Southern Sierras Power Company, Riverside, Calif., and Bureau of Water Works and Supply, Los Angeles, jointly, plan 33,000-volt, 21-mile wood-pole transmission line.

Nine Coffin Fellowships

Continuing its policy of awarding fellowships to graduates of technical schools and colleges, the Charles A. Coffin Foundation, established by the General Electric Company, has this year made nine awards entitling the recipients to the opportunity to follow highly technical research activity. Cosmic rays and invisible corona and its effects upon rubber-insulated cable are among the studies to be undertaken.

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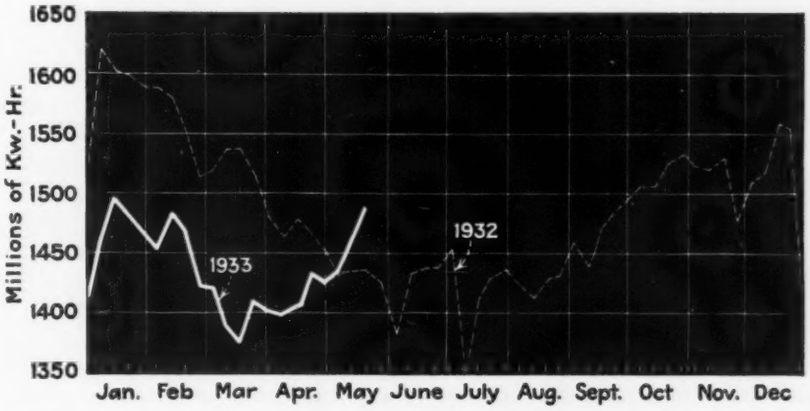
Output 3.3 Per Cent Above 1932



By a further rise from the last preceding figure, energy output of electric light and power companies during the week ended May 20 overshot that of the corresponding week of 1932 by 3.3 per cent. Production amounted to 1,483,090,000 kw.-hr., the Edison Electric Institute announces.

Thus for the third consecutive time last year's operations have been surpassed, and by a progressively greater margin. With the highest output since mid-January the gain over the week of March 18 becomes 8 per cent.

The Central industrial area is now well ahead of last year. Progress continued in the East. New England's lead again passed 7 per cent. The Pacific Coast area alone lags.

Weekly Output, Millions of Kw.-Hr.

Week ended	1933	1932	1931	1930
May 20	1,483	1,436	1,645	1,723
May 13	1,468	1,437	1,654	1,717
May 6	1,436	1,429	1,637	1,689
April 29	1,428	1,455	1,644	1,698
April 22	1,431	1,470	1,676	1,725

Per Cent Change from Previous Year

Region	Week Ended May 20	May 13	May 6
Atlantic Seaboard	+5.0	+4.2	+2.9
New England alone	+7.1	+7.7	+3.8
Central industrial	+3.5	+1.4	—0.2
Pacific Coast	—7.2	—7.2	—3.5
United States	+3.3	+2.2	+0.5

North approach to the Hall of Science, Century of Progress

Policies in the Public Interest

ELECTRICAL men are intelligent and alert. They anticipate and act in accord with changing forces and changing sentiments. Notable evidence of this is had in the reorganization of the light and power industry. The new Edison Electric Institute has a constitution that is an advanced model for a pledged trade association. It commits members to policies and practices that are in the public interest as well as in that of the industry.

Holding companies have reorganized and have adapted themselves to new conditions. Decentralization of authority with full responsibility on operating property executives, full publicity on balance sheets and investment holdings, changed practices for service charges to subsidiaries, elimination of pyramid organizations, abolition of affiliated security houses, engineering firms and appliance companies and many revisions in corporate and capital structures afford ample evidences that these utilities are putting their houses in order.

In the face of the depression the utilities have lowered rates, paid increased taxes and refrained from paying dividends in many instances. They have worked to reduce costs, increase sales and improve their practices. In a full spirit of co-operation they have been active in local communities and in the national councils to aid the unfortunate and to bring back prosperity. They have proved to be a national asset in this time of emergency. Their record is splendid.

A constructive development during the year has been the conscientious effort of utilities to build up co-operative merchandising in local communities. These efforts have held up sales and have gone far to stop both alleged bad business practices and agitation for legislation to force utilities out of merchandising. The local sales efforts have been supplemented with rate reductions and the institution of inducement rates that aid greatly in selling service and appliances.

Utility financial affairs are remarkably good considering the low business. The majority of properties have earned fixed charges and in general preferred dividends have also been paid. Undoubtedly, however, utility security maturities of some $224,000,000 in 1933-34 create a burden that will make it necessary to pass dividends this year in most instances in order to conserve cash. The total maturities to 1937 amount to more than $550,000,000. Thus the 1,535,000 utility stockholders will suffer in income temporarily, but there are indications of an improvement in business at present that may change the situation before the year is out.

Taxes have been mounting steadily and place a very definite handicap on service expansion. Utilities cheerfully pay taxes, but increased taxation necessitates increased earnings, and these cannot be had until business improves. Nor is it feasible to have rate increases to correspond to taxation increases. State and national utility taxes should be reduced as soon as possible in the public interest.

Another hazard facing the industry comes from the changes in the value of the dollar. Investment values will be conserved if the 1926 dollar value is brought back, and this appears to be the plan of the administration. But if this does not occur recent Supreme Court decisions indicate that present values will be predominant in fixing rates. It may be that capital write-off must be had in future and this would necessitate increased rates. A refunding capital policy permits of the lowest rates to the public, but present happenings indicate that there is no inherent protection of the industry against changes in investment values, so the industry must of necessity protect itself.

At this time there are some clouds on the utility horizon, but they will drift away with a revival of business. Agitation for rate reductions continue in many localities, taxation, both local and national, threatens to be increased, hostile legislation promises to instigate some local competition on a governmental subsidy basis such as the Tennessee Valley and the St. Lawrence. But these are normal conditions to be expected in a depression period. These trials and tribulations are superficial.

On the asset side, however, the utilities have many splendid things to encourage them. Markets are still being sold, loads are coming back, technological progress makes it possible to improve service and lower costs, bank loans have been reduced, the security markets have revived and utility organizations have been improved. The industry is ready to go forward and to prosper with a revival of business.

Power Sales—Watch Them Grow

Probably the most encouraging feature of the utility business is the sanity exhibited by utility managements with respect to public relations. No longer is it the endeavor to shout, to brag, to lobby and to create an impression of ballyhoo in the public consciousness. Public relations has become a part of the daily work of each utility man and public favor is sought only upon the basis of the quality of service rendered. The utilities have become modest and sensible and have given up seeking glory in the public limelight through lip service. The old time N.E.L.A. circus at Atlantic City has given way to a quiet meeting of industry leaders who discuss industry problems for their own benefit. Industry meetings are for industry improvement in the public interest—not for publicity purposes.

The new actions on organization and policy are sound. They will be successful in the degree that all companies co-operate and live up to the accepted ethics and practices. Perfection has not been reached, but the roads have been charted and the initial movements inaugurated that should enable utilities to go forward under the leadership of able managers whose sole endeavor is to be successful as purveyors of light and power service to the customers on their lines.

Power Sales—Watch Them Grow!

In the electrochemical industries alone Dr. Colin G. Fink expects that double the present amount of energy will be in use in the next ten years—think of 30,000,000,000 kw.-hr. per year for furnaces, plating, electrolytic production of metals, aqueous electrolysis, production of salts and acids and for other purposes. Electric steam boilers, large and small, are finding a market—electric welding in industry and construction is coming into full favor—new rotary molds for steel ingot casting is only one item in the many that show that electric heat and power are revolutionizing steel manufacture—annealing and heat treating of metals and alloys is on the increase—electric steel alloys are in demand and electric gray iron foundries are making money—modernization is calling for new motors, transformers, lamps and controls in all industries.

News comes of electric soil sterilization and of electrically heated hotbeds—food and tobacco products are using corona treatments—frozen fish, meat and vegetables open new markets—air-conditioned hotels, office buildings and restaurants are necessary in modern affairs—lighting for streets, highways, factory production and merchandising is at a very low level both as to intensity and practice and offers a large market—the decentralization of industry is bringing new factories that call for motors and other electrical equipment—the railroads plan to increase their electrified mileage—the cost of power is low and is decreasing and this means more use in all markets—old plants whether, in manufacture or raw material production, must modernize to survive. Electric power, heat and light sales opportunities are numerous and all these loads will be served sooner or later.

The competitive position of the industry improves steadily. Technological advances and lower costs enable the utilities to sell the power markets by use of lower and better-devised types of rates. The competition of the small industrial plant is on the decrease and the competition of the gas industry is less effective in many localities. New electrical products and processes from research laboratories are numerous and widen the field for sales. A sane perspective on the depression weighs the actual decrease in industrial energy use against what will happen with a general revival of business. Conservative opinion is that the use of energy will increase very rapidly and that the ten-year trend line will again be met in a very short time. There is no evidence of saturation under normal business conditions and there is a great deal of evidence that indicates a very rapid expansion of the electrical industry with the recovery of general business.

Many things have worn out during this depression. Practically all electrical equipment is obsolete in the sense that it can be replaced by improved equipment that is less expensive and better in performance. Many old manufacturing

The Future of Domestic Revenue

and construction methods and processes have changed with the advent of welding, synthetic materials, demands for higher quality and demands for new standards such as air conditioning. New industries have been developed to make new products or to replace old products. This readjustment period has meant stagnation only with respect to sales; it has meant development with respect to the coming business era. The *status quo* has been abolished and in most instances technological and commercial progress calls for a greater and a wider use of electricity in all industries. This is the significant aspect of the power market that forces the electrical industry to be very optimistic about the future.

The Future of Domestic Revenue

Domestic load looms large in the present commercial outlook of the power industry. Income from residence consumption has been a life saver through the past years of depression and is needed today as never before. It is unfortunate that the situation is now beclouded by political considerations, so that sales policy is in doubt, revolving largely around the question of whether or not utilities should merchandise appliances.

Executives are anxious because they have watched the volume of residence business fall off in the last few months, while at the same time public and political clamor for rate reductions has increased and opposition by dealers to utility merchandising continues. For the fact that the proposed legislation has been fading out and dealer demands are less aggressive does not constitute a victory. It is only a truce, unless the sentiment from which it springs can be changed. The principles must be dealt with and the marketing of load-building domestic appliances to the community must be assured on a basis of permanence before the problem is solved.

Three points stand out as inescapable: (1) If rates are to be lowered, because public opinion demands that electric service should be cheaper than in 1929, like other household expenses, then increased income must be developed from larger consumption in the home; (2) increased domestic load can only be built up by selling appliances; (3) to do this selling will call for all the resources and man-power of the entire local electrical industry. The best results cannot be obtained by the power company working alone or by the dealers alone, but by both working in creative co-operation. For there are some functions of load building, of a research or development or educational character, which the dealer cannot undertake and finance from merchandising profit.

Most utility sales managers are eager to do a good job of domestic load building through aggressive merchandising. But the top executives seem to be increasingly against it. They want the load, but they are afraid of the political aspects of merchandising. And most companies appear to have overlooked the fact that the right sales policies can do as much to create harmony in the trade as wrong policies can cause discord. For sound and constructive merchandising co-operation develops a genuine basis of friendship and mutual support between the power company and the local merchants that has great political value. For when many department and hardware stores and specialty dealers are building load, it means also that many dealers are building the popularity of electric service and increasing the energy consumption by present customers.

The problem is broader than the mere question, To merchandise or not? Rather, the issue of the next few years is how to organize the household appliance trade in the community to hasten the complete electrical equipment of all homes that residence load may increase rapidly. It calls for fundamental planning and courageous executive leadership, and in some cases it will be accomplished by a co-operation in which the utility does no actual retailing itself. But the future of domestic revenue in the next few years will depend upon how well this job is done. For these policies will not only provide for larger sales of present appliances, but pave the way for the air-conditioning market and other developments that are to follow. What this will mean in dollars of revenue to the power company needs no comment.

Utilities Meet Their Crisis . .

FOUR indexes show pretty well the status of the electric utilities from the financial standpoint. Industrial power revenue is at a low ebb. Domestic consumption has declined slightly, although some companies are enabled to report an increase. Dividends have been pared in many cases, omitted in others and bond interest of operating companies defaulted in a few isolated instances. Maturities to be faced in 1933-34 amount to $160,000,000 in bonds and $84,000,000 in notes and debentures; the operating companies involve 90 per cent of the notes and 80 per cent of the bonds. Stockholdings of operating electric utilities have changed little from the 1931 proportion of 1,535,522 holders of all classifications, 68,946 of which were employees and 1,097,872 were non-employee customers of companies whose stock they held. Delinquent accounts have amounted to large totals.

Between now and the end of 1937 the electric operating companies and holding companies will have to refinance (see Table I) a half-billion dollars worth of notes, debentures and bonds. Nearly 80 per cent of this is in bonds and the operating companies will have more than three-fourths of this 80 per cent to face. For this calendar year 1933 it happens, undoubtedly fortunately, that the refinancing is less than in any of the four years which follow. This is also true of the operating companies alone. But for the holding companies the bonds, notes and debentures amount to a greater total than they will on present commitments in 1934, 1936 and 1937. In both groups the notes and debentures fall off, as is to be expected from their short-term characteristics. The year 1935 is the peak year, with $108,298,200 in all categories to be met.

Decline in revenues to the extent of about 8 per cent over the last year has resulted from several causes. For the whole industry the industrial consumption has fallen off about 25 per cent in three years, but in the large industrial centers 50, 60 or even 75 per cent shrinkage has not been uncommon. Street lighting has been curtailed, in some quarters drastically, and commercial consumption has declined moderately. Domestic usage has held up well, even increased notably in certain areas, but nationally there has been a decrease of more than 5 per cent.

Delinquency in payments has become a serious problem, although a few companies are so placed

(Please turn to page 670)

Table I — Half-Billion of Electric Utility Maturities Over Next Five Years

(Poor's Manual)

Year 1933:	Operating Companies		Holding Companies		Total	
	Notes or Debentures	Bonds	Notes or Debentures	Bonds	Notes or Debentures	Bonds
January	$30,000,000	$17,557,500	$	$	$30,000,000	$17,557,500
February		4,079,500				4,079,500
March		50,000		377,000		427,000
April		2,589,000		2,000,000		4,589,000
May	10,000,000	13,958,500			10,000,000	13,958,500
June	6,560,000	6,388,500		10,000,000	6,560,000	16,388,500
July		710,500				710,500
August		374,000		1,759,000		2,133,000
September	180,000				180,000	
October		1,646,000	3,585,300		3,585,300	1,646,000
November		5,415,700		996,000		6,411,700
December		60,000		4,450,000		4,510,000
Total	$46,740,000	$52,829,200	$3,585,300	$19,582,000	$50,325,300	$72,411,200
1934 total	26,517,700	76,566,900	7,465,809	13,063,000	33,983,509	89,629,900
1935 total	28,840,700	68,373,200	1,200,000	39,925,000	30,040,700	108,298,200
1936 total		66,162,400	2,300,000	9,329,200	2,300,000	75,491,600
1937 total	13,056,200	74,519,790	1,388,500	1,229,500	14,444,700	75,749,290
Grand total	115,154,600	338,451,490	15,939,609	83,128,700	131,094,209	421,580,190
Total maturities of all kinds						$552,674,399

. . by Readjustment to Conditions

Table II — Preferred and Common Stocks of Operating Companies Widely Held

	Number of Stockholders	Number of Shares Held	Average Number per Shareholder
Alabama Power	15,855	4,015,561	254
Arkansas P. & L	8,094	135,053	17
Calif. Oregon Pwr	6,586	85,989	13
Central Ill. Pub. Serv	22,942	544,764	24
Central Hudson G. & E	7,233	1,570,000	217
Central Maine Power	20,275	198,997	10
Central P. & L	8,191	135,411	17
Cleveland Elec. Illum	7,462	2,707,287	363
Commonwealth Edison	65,034	1,620,766	25
Cons. Gas of New York	113,217	13,575,676	120
Cons. Gas, E. L. & P., Balt.	19,720	1,390,029	71
Consumers Power	42,561	706,954	17
Dallas P. & L	5,092	337,151	66
Detroit Edison	13,715	1,272,260	93
Edison of Boston	15,674	534,875	34
Georgia Power	12,898	3,501,849	271
Hartford Elec. Light	11,234	837,522	75
Jersey Central P. & L	10,525	220,411	21
Kansas G. & E	6,217	81,903	13
Kentucky Utilities	11,504	184,194	16
Louisville G. & E	13,307	213,798	16
Los Angeles G. & E	6,278	395,141	63
Milwaukee E. Ry. & L	15,652	197,956	13
Monongahela West Penn	5,484	876,000	160
New England Power Assn.	17,993	1,642,054	91
Northern Ind. Pub. Serv	16,691	229,679	14
Northern States Pwr	71,629	790,132	11
Northwestern Pub. Serv	5,146	45,845	9
Ohio Edison	12,336	297,776	24
Oklahoma G. & E	9,462	172,125	18
Pacific G. & E	84,705	10,820,335	128
Penn Central L. & P	13,662	376,053	28
Potomac Elec. Power	4,787	130,000	27
Pub. Serv. of N. Hampshire	9,090	94,550	10
Puget Sound P. & L	24,783	1,537,413	62
Southern Cal. Edison	123,068	7,910,000	64
Southwestern G. & E	6,059	94,506	16
Tampa Electric	4,935	576,895	117
Tennessee Elec. Pwr	14,527	240,822	17
Union E. L. & P	12,123	2,425,000	200
Virginia Pub. Serv	6,689	96,277	14
Washington Water Pwr	6,774	2,634,346	386
Western Massachusetts Cos.	8,163	997,499	122
West Penn Power	9,500	3,072,077	323
Wisconsin P. & L	18,575	168,367	9
Wisconsin Pub. Serv	10,746	111,525	10

Table III — Number of Stockholders — Operating Electric Utilities — 1931

	Customer Owners: Employees	Customer Owners: Customers	Other Individuals	Total
United States	**68,946**	**1,097,872**	**368,704**	**1,535,522**
Massachusetts	3,631	27,697	6,711	38,039
Maine	496	18,567	3,299	22,362
Connecticut	2,000	12,000	3,000	17,000
New Hampshire	772	7,488	2,820	11,080
Rhode Island	220	4,141	2,444	6,805
Vermont	121	1,999	1,389	3,509
New England	7,240	71,892	19,663	98,795
New York	10,500	208,000	75,000	293,500
Pennsylvania	5,383	58,737	16,504	80,624
New Jersey	600	8,800	4,000	13,400
Middle Atlantic	16,483	275,537	95,504	387,524
Illinois	3,341	85,732	33,811	122,884
Michigan	4,181	54,226	16,668	75,075
Ohio	3,000	47,000	13,000	63,000
Wisconsin	1,635	50,490	4,075	56,200
Indiana	2,000	30,000	10,000	42,000
E. N. Central	14,157	267,448	77,554	359,159
Minnesota	2,020	54,129	1,380	57,529
Iowa	1,500	21,000	8,000	30,500
Missouri	900	12,071	4,938	17,909
Kansas	375	11,548	3,155	15,078
Nebraska	360	6,000	1,300	7,660
South Dakota	200	6,586	666	7,452
North Dakota	81	6,187	1,171	7,439
W. N. Central	5,436	117,521	20,610	143,567
Maryland	818	12,573	7,300	20,691
Georgia	699	7,977	6,867	15,543
Florida	1,642	5,012	4,566	11,220
Virginia	809	8,692	1,638	11,139
West Virginia	500	8,000	2,400	10,900
North Carolina	500	7,000	1,000	8,500
D. of Columbia	71	4,424	374	4,869
South Carolina	150	2,000	850	3,000
Delaware	120	1,200	300	1,620
South Atlantic	5,309	56,878	25,295	87,482
Kentucky	1,300	15,400	15,200	31,900
Alabama	....	15,000	5,000	20,000
Tennessee	1,050	11,500	6,600	19,150
Mississippi	265	5,939	598	6,802
E. S. Central	2,615	47,839	27,398	77,852
Texas	2,459	18,016	10,821	31,296
Louisiana	1,200	9,400	7,500	18,100
Oklahoma	586	6,089	9,928	16,603
Arkansas	541	6,210	4,120	10,871
W. S. Central	4,786	39,715	32,369	76,870
Utah	906	12,323	3,855	17,084
Colorado	446	10,909	3,024	14,379
Idaho	433	4,105	1,424	5,962
Nevada	151	717	1,803	2,671
Arizona	153	1,091	475	1,719
Wyoming	63	867	309	1,239
Montana	17	600	105	722
Mountain	2,169	30,612	10,995	43,776
California	8,583	162,133	50,373	221,089
Washington	1,740	22,346	6,194	30,280
Oregon	428	5,951	2,749	9,128
Pacific	10,751	190,430	59,316	260,497

Duplication Joins Doubling . .

UP HAVE gone taxes. There may never be an end to them, but there might decently be a limit. If that cannot be, at least there might be less duplication and triplication. However, when a nation spends like a drunken sailor it can expect a day of reckoning. The reckoning is made by the tax assessor juggling figures on a scrap pad just to make the totals come big enough, let the heavy hand fall where it may. Small wonder that taxation has been doubled and duplicated in the effort to keep pace with ballooning budgets. For the electric utilities the double and triple collections have mounted rapidly in the last three years to within an inch of the intolerable.

Paying taxes on all of what you have, all of what you earn, practically all of what you sell, much of what you buy and a bit on what you borrow gets to be irksome, to say the least. It gets to be devastating, to say the worst, if it has a punitive tinge verging on the confiscatory. All of these forms and shades of taxation exist in the case of the electric utilities. Two years ago the total tax paid for all purposes represented more than 10 per cent of the gross revenue of the industry, and with the unshiftable 2 per cent federal tax on domestic and commercial energy in the picture it means for 1933 revenue roughly 13 per cent of the gross because the existing taxes, whether fixed or growing in amount, have assumed an increased proportion with respect to declining gross. As far as proportion to net revenue is concerned the net has shriveled far more than gross and consequently the total tax payment in proportion to net represents considerably more than 25 per cent because net operating revenue is substantially less than half the gross.

A federal tax of 2 per cent on domestic and commercial energy means 1⅓ per cent on gross revenue and is equivalent to about 3 per cent on net revenue. Along with the corporation income tax of 13¾ or 14½ per cent (depending on whether it is a single or consolidated statement) makes the payments to the federal government alone amount to more than 17 per cent of net revenue after only operating expenses are deducted from gross revenue. The other 10 per cent of net revenue goes for taxes to states, counties, municipalities, towns and school districts, directly or through assessment for the support of special bureaus and departments.

States and the nation get their joy principally out of taxing the corporate transactions and the less tangible evidences of wealth and earning power. The nearer one gets to tangible property the more one finds the smaller political units active. The inability to segregate the tangible from the less tangible and the intangible has led to an intricate maze of duplicated and overlapping taxation. This pressure for revenue to support an insupportable volume of governmental activity has inspired a wave of encroachment on taxation areas and functions previously reserved for distinct political subdivisions.

Duplication in sales and income taxes

States and the nation both have income taxes. Both tax the revenue from energy sales. Others have a sales tax which cannot be wholly dissociated from the specific tax on energy. Some impose a tax on gross revenue in lieu of all property taxes. Others add such a tax to the general property tax. Over and above all these are merchandise sales taxes, taxes on security issues and transfers, licenses and permit fees. Utilities also pay directly or indirectly taxes on services and commodities they buy—automobiles, tires, gasoline, oil, telephone, checks, etc. Perhaps these latter should be classed with "good citizen" taxes. One real basis for legitimate complaint is on the nefarious duplication of taxes and the reciprocal usurpation by both federal and state governments of fields which logically belong to the other.

Property taxes on real and personal property are primarily a local matter. So are franchise taxes and permit fees of various sorts. The nation-wide interest is in the duplication of taxes in the income and sales class. It makes no difference who has done the imitating, the imitation and the duplication are there and they are conducive to a race between the two contestants to see which can extract the largest levy first. There seems to be a bit of glee in this process and that's where the punitive tinge creeps in along with all the onus of duplication.

In 1932 the federal government enacted a 3 per cent consumer tax on non-industrial energy. Some 23 states and territories have special taxes comparable to this either in the form of a sales tax, gross receipts tax or franchise tax. Perhaps only eighteen of these could properly be called sales taxes, since they are based on gross receipts

. . to Make Taxes Ominous

from kilowatt-hour sales or on kilowatt-hour output. The gross receipts tax varies from ½ per cent to 5 per cent (see table). Duplication of federal and local taxes in the one category alone may result in a rate as high as 6½ per cent. Twenty states, not to mention Hawaii and Alaska, have special franchise taxes bearing on the energy magnitude for revenue. Seventeen states and Alaska make this franchise imposition in addition to a general property tax, and three states, along with Hawaii and the District of Columbia, impose it in lieu of property taxes. Mississippi and West Virginia are among the seventeen which make the tax additive and they do it through the medium of a general sales tax which embraces electricity.

More states are joining the mêlée

In addition to the specific local taxes enumerated in the table there are the following: Kentucky has a franchise tax which already takes more than $300,000 from the utilities; the originally proposed federal tax of 3 per cent on all energy would have increased this by another $325,000. Georgia takes 0.3 per cent on gross. Ohio has levied 1 per cent on gross and, for special relief purposes, has levied an added 1 per cent. The federal 3 per cent tax would have taken $1,900,000 more out of this state. During 1933 the following states passed franchise taxes or taxes on gross: Arizona, Illinois, Indiana, Kansas, Nebraska, North Dakota, South Dakota, Utah, Washington. Under consideration by the 1933 legislative assemblies there were also similar taxes in the following states: Colorado, Iowa, Maine, Michigan, Minnesota, New Mexico. More states now have some form of specific tax on utilities than have so far chosen to impose comprehensive regulation on these utilities. It looks as if regulation by the tax assessor bids fair to supplant regulation of rates by a utilities commission.

Tax Levies Affecting Electrical Energy Sales*

	Form of Tax	Estimated Tax Revenue
Federal Government	Three per cent on sales price	$32,000,000
Franchise Taxes in Addition to Property Tax		
Alabama	Four-tenths of 1 per cent on gross receipts (state)	$90,000
	Two-fifths mill per kilowatt-hour (state)	600,000
	Two per cent gross receipts (city)	400,000
Alaska	One-half of 1 per cent gross receipts	Uncertain
Connecticut	One and one-half per cent gross receipts	450,000
Delaware	One-tenth of 1 per cent gross receipts	3,500
Idaho	One-half mill per kilowatt hour.	325,000
Maryland	One per cent gross receipts	200,000
Nevada	Two per cent net income	20,000
North Carolina	Five per cent gross receipts	1,600,000
Ohio	One and thirty-five hundredths per cent gross receipts	1,550,000
Oklahoma	One-half of 1 per cent gross receipts	115,000
Oregon	$1 to $3,000, based on gross volume	Uncertain
Pennsylvania	Eight-tenths of 1 per cent gross receipts	1,500,000
South Carolina	Three-tenths of 1 per cent gross receipts	45,000
	Three-tenths of 1 per cent property value	275,000
	One-half of 1 mill per kilowatt-hour	550,000
Texas	One-half of 1 per cent gross receipts	$750,000
Vermont	One-half of 1 mill per kilowatt-hour	250,000
Virginia	One and one-eighth per cent gross receipts	250,000
General Sales Taxes		
Mississippi	Two per cent gross receipts	150,000
West Virginia	Six-tenths of 1 per cent gross receipts	170,000
Total local		$9,193,500
Total national		$42,193,500
Franchise Taxes in Lieu of Property Tax		
Hawaii	One-twentieth of 1 per cent gross receipts, plus one-fiftieth of 1 per cent stock valuation, plus one-half to 2½ per cent gross receipts as per charter.	
California	Seven and one-half per cent gross receipts.	
Rhode Island	One per cent gross receipts.	
Dist. Columbia	Four per cent gross receipts.	
New Jersey	Average property rate on gross income.	

*Tax statistics from 1933 House committee print on "Double Taxation"; tax estimates by Vice-President Hagenah of Edison Electric Institute before Senate committee on finance, May 2, 1933.

Tax Duplication Ominous

What does it all mean? It means already paying 75 per cent more in taxes than for the coal consumed by the electric utilities. It means already paying 44 per cent as much in taxes as for all payrolls. It means that sixteen companies already in financial distress and 25 on the verge of it (a list of these was supplied off the record to the Senate finance committee by Mr. Hagenah) will be thrown into receivership. It means that all the economies in administration will go for naught in so far as they have averted wholesale unemployment and reduction of wages and spending capacity of the employees in their communities. It means that taxes are being assessed and collected by the more favorably situated utilities in amounts comparable in magnitude to the aggregate of delinquent accounts of municipalities for street lighting and of individual consumers unable to pay. It means in one case paying a quarter of a million in taxes at the same time that three-quarters of a million in delinquency is being carried on the books. It means possibly the abrupt termination of service to some if tax collection wipes out all the margins.

It means cessation of rate reductions in some cases and in other cases, like the electric railways during the war, inescapable necessity for increased rates. It means that 1,100,000 customers, 70,000 employees and other local citizens who, constituting 1,535,000 stockholders, have put their savings into preferred and common stocks of locally administered operating companies will find their earnings and investments clipped. It means that many bonds of utilities will be no longer valid for savings bank investment. It means a vicious departure from the "ability to pay" principle in favor of a special tax on the gross receipts of a special industry for a special and unhallowed purpose. It means a drastic blow at one of the few industries that has been able to maintain a wholesome semblance of stability throughout this period and just at a time when resumption toward stability is the prime requisite of the moment in all quarters. It means inability to meet competition. It means destruction of confidence on the part of the investing public. It means higher cost for $552,000,000 of refunding money in the next five years when for every other industry money is getting ready to be cheaper and more fluid. It means only that back of this race in tax duplication and doubling is a blind intent to tax the utilities out of existence in much the same way that the railroads have been "rated" and "competed" out of decent existence.

Utilities Meet Their Crisis by Readjustment to Conditions

(Continued from page 666)

as not only to be tolerant on this point but even to make public announcement of their practical exercise of magnanimity in accepting notes. According to Mr. Hagenah's testimony before the Senate finance committee four companies operating over wide areas report an enormous increase in municipal delinquency. Billings of $17,000,000 in this class entail items 25 per cent of which have persisted in delinquency until they are virtually to be classed as uncollectible. In March the total delinquency accounts of all electric utilities totalled approximately $100,000,000, of which $25,000,000 was for municipal account, principally street lighting. Nevertheless the utility in one instance paid $240,000 in a tax on gross to the state, while municipals in the same state used $700,000 of electric energy for which they have paid nothing and may never be able to pay in full.

Evidence of readjustment is sharply visible with respect to dividend trimming. Among those companies which recently saw the need of omitting or deferring cash payment of preferred dividends were Utah Power & Light, Mountain States Power and General Gas & Electric. Companies which cut preferred dividend rates, in some cases half, have been American Power & Light, Arkansas Power & Light, Carolina Power & Light, Northern Indiana Public Service, Virginia Power & Light. Quite naturally the common dividends suffered most, being omitted entirely, of course, where preferreds were cut or omitted. In addition the following companies have lately announced a reduction in rate on common: Cleveland, Detroit, Philadelphia Company, Public Service of New Jersey, Standard Gas & Electric, Standard Power & Light.

New Developments in Engineering

Scientists, inventors and engineers are busy. During this depression the present art and practice has been surveyed and many new and improved devices and practices have been made commercial. Still others are in an embryonic commercial stage. Technological progress has never been so rapid **in all aspects of engineering.**

Power Generation

Alternating-current turbo-generators of 36,000 volts with 66,000-volt machines contemplated—in addition to the use of mercury in a binary-cycle, both diphenyl and aluminum bromide are suggested—outdoor steam station with 200,000-kw. units connected together only through multi-secondary auto-transformers contemplated—new governors for internal combustion engines—explosion and rotary type boilers developed—great reduction in space and cost by use of new equipment and designs—use of many small stations preferred to single large stations.

Power Distribution

Network principle applied to both primary and secondary systems—factory-built substations available in standard ratings—self-protecting transformers of several types—new and better arresters, relays, breakers and fuses—automatic step-regulators combined with transformers—new standardization on meter and meter attachments for indoor and outdoor service—new wiring materials and devices and advent of concentric wiring—small breakers to replace fuses—electron tube controls and relays—new types of underground cables and conduits.

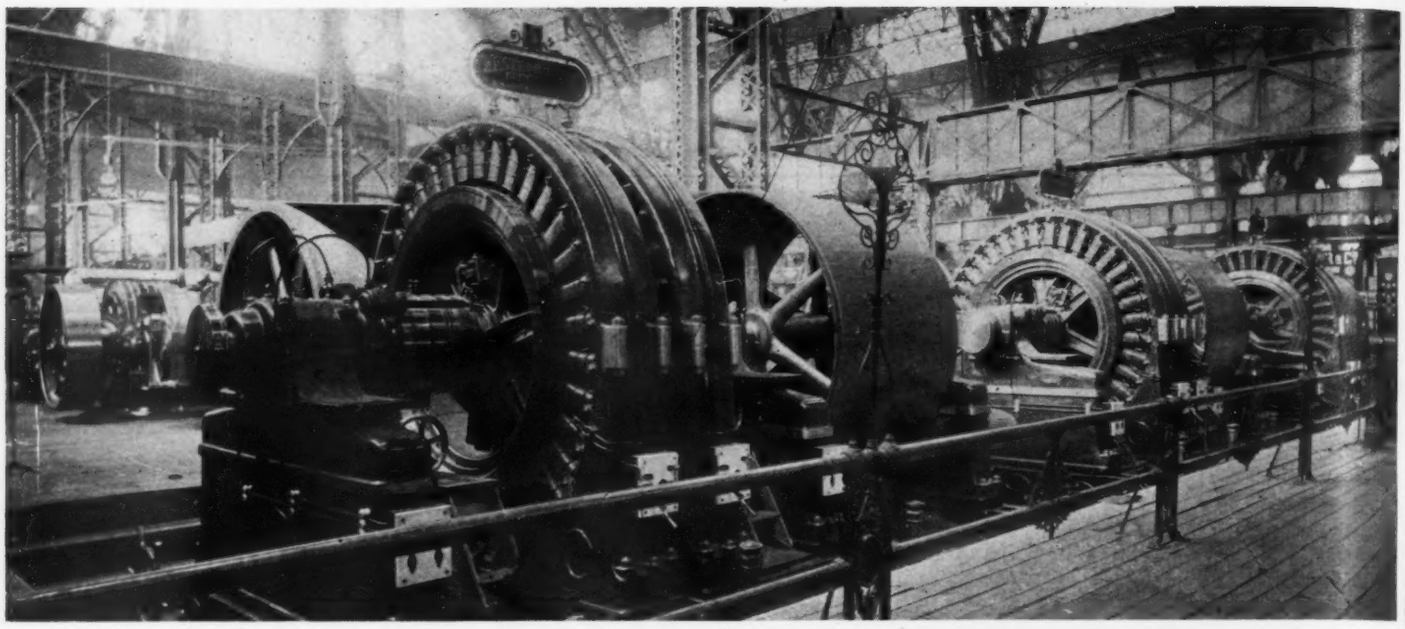
Power Transmission

Continued progress on high-voltage direct-current transmission—330,000-volt lines under construction—lightning-proof lines prove successful—high-voltage breakers improved in performance—use of high-voltage metal-clad substations on the increase—gas-filled high-voltage cables in experimental stage—oil-filled high-voltage cables prove successful—automatic sectionalizing provided by new relays—stability problems solved—wood-pole construction shows improved performance and gives lower costs—new arresters and fuses developed—gas-filled synchronous condensers used for regulation—automatic tap-changing transformers with lightning protection.

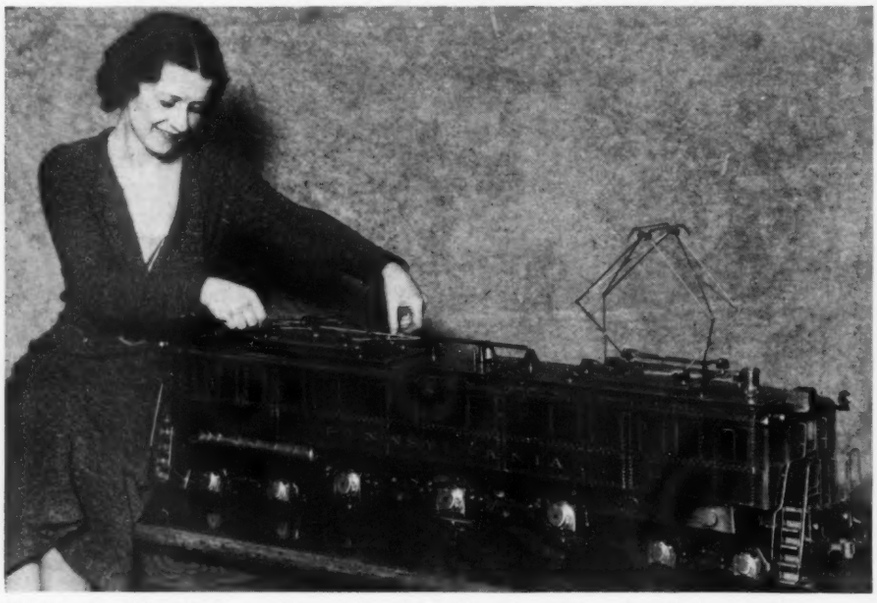
Utilization Devices

New relays for synchronous motor excitation control—new instruments for use on production machinery to measure time and energy—X-ray inspection of electric welds—direct reading illuminometer—induction electric heating of liquids, gases and metals—explosion-proof motors—gaseous street lights—electronic tube applications multiply in industry—geared motors developed—wider use of electricity in electrochemical industries—corona discharge for food products—soil sterilization by electricity—many new appliances developed—grid control rectifier—stall-safe motor—air, steam and blowout breakers—Kondo railway drive—air-conditioning equipment.

Changes in dollar values, changes in design ideas and new technological developments have been so rapid in the past three years that more than half of the present electrification of America is obsolete technically and economically—all this must be rebuilt sooner or later. And, in the meantime, still more new things appear daily on the horizon as developments of scientists, inventors and engineers. There is no stopping point in electrical technological progress.



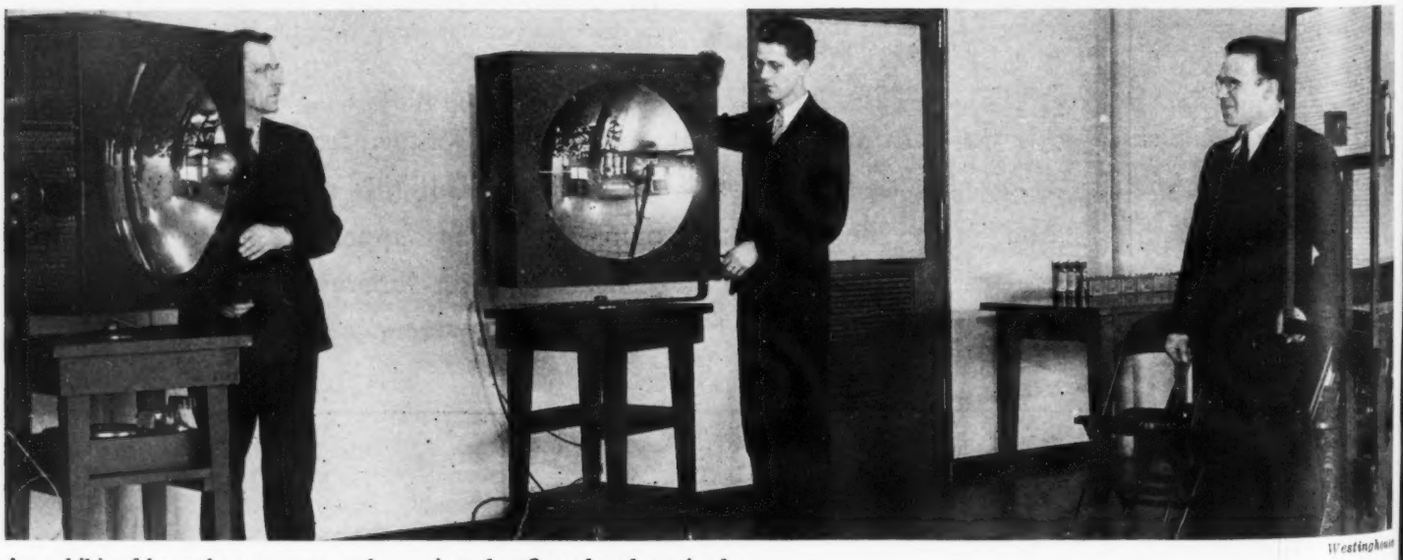
Three of the twelve 2,000-hp. Westinghouse generators which supplied power to 1893 Fair and proved the value of alternating current



Model of a Westinghouse Pennsylvania Railroad modern electric locomotive

General Electric

50-kw. incandescent lamp and grain of wheat lamp



Westinghouse

An exhibit of how short waves can be projected, reflected and received

The Once-Over on Electrical Exhibits

Anticipatory tour astonishes—startling displays of power, light, communication and science—electricity makes the Century of Progress a wonderland.

FROM Gorilla Villa to the agricultural exhibits electricity is the keynote of A Century of Progress. Without electricity there would be no fair at all, none, that is, in the form and appearance of this particular one. The startling, but beautiful, architecture would be impossible, for a feature of the buildings is the absence of windows, requiring artificial light in the daytime. There would be no gorgeously spectacular night displays, except perhaps expensive and special fireworks. There would be no thrilling Sky Ride and very few, if any, of the numerous concessions and exhibits that depend for operation on electric power.

If the visitor wants to be instructed painlessly and rapidly in the elements of electricity, let him clutch the hand rail for half an hour in front of the models of basic experiments and demonstrations in the Hall of Science. There is a whole series of these, each one operating. The series begins with a diorama of Ben Franklin and his kite. There's old Ben standing in the harness shed, out of the rain, and on the kitestring the big brass front door key from which the electricity jumps in a spark to the Leyden jar. When you look at this remember how the neighbors expected to carry Ben home on a shutter after the thunderstorm was over. He went Ajax one better; he not only defied the lightning, but dragged it down from the sky and put it in a bottle. Here is Oersted's experiment, the first proof that electricity and magnetism were related, a magnetic needle changing its position with changes in the direction of electricity flow. Here are the discoveries of Volta, Galvani, Faraday, Henry, Ampère, Edison and many others, each model operating to show in easily comprehensible fashion the particular fact it illustrates.

Having now accumulated an electrical education, our visitor wanders out on the terrace of the Hall of Science and looks across the lagoon at the huge semi-circular bulk of the Electrical Building, its vivid colors brilliant in the sunlight. On the advice of a friend, returned like Sinbad, from seeing many marvels, he saunters across the bridge and passes through the Hall of Social Science, where he is tempted to stop, but presses on, since today he is on the trail of electricity.

He comes first on the telephone and telegraph exhibit, a sort of amphitheatre around a well opening to the floor below and whose walls are lined with the infinite complexities and ingenuities which are the means of modern local and long-distance communication. Here are all the wonders of the Bell Telephone Laboratories, scrambled speech, delayed transmission, graphic transmission, all of the related developments of sound and electricity plus, also, some very intriguing possibilities in the field of sight and electricity. Then through a long corridor, where on one side are displayed the diverse products of the Stewart-Warner Corporation, from all-wave radios to speedometers. On the other side the Electric Storage Battery Company asserts that "Every Day in some Way an Exide Battery Serves You" and proceeds to prove it with illuminated paintings of battery uses and with displays of the specific types concerned.

At the end of this corridor he comes upon an intriguing thing. He pokes his head over the rim of a huge bowl the bottom of which is a pictorial map, translucent and lighted from below, which is the exhibit of the Commonwealth Edison Company, Public Service Company of Northern Illinois, Western United Electric & Gas Company and Illinois Northern Utilities Company, the four electrical systems serving the Chicago area. A pencil of light points out a spot on the map, a recorded voice tells what power house or substation is located there, while on a screen at one side of the bowl appears a picture of the particular structure.

Tearing himself away from this the visitor comes out at one end of the great 550-ft. half circle which is the main hall of the Electricity Building. Straight ahead is the entrance to "Electricity at Work," the exhibit of the light and power companies of the country. Above this entrance rises a 40-ft. wall on which, framed in burnished copper, is the gigantic figure of a man, also of copper, symbolizing the wresting of electricity from Nature and its employment for men's needs. Turning his gaze to the left, the visitor looks down a broad flight of steps, red walls rising high on either side and aflame with vertical lines of neon lighting, into the main hall.

The Once-Over on Electrical Exhibits

He cannot see its full length because of its curvature, but he receives a tremendous impression of distance from the diminishing perspective of a series of massive columns that, brilliant with light and color at their feet, rise in increasing shadow to the murky darkness of the black ceiling 85 feet above. These columns, covered with paintings by Charles B. Fall of scenes and events significant in the history and application of electricity, are the outstandingly spectacular feature of the General Electric exhibit.

Walking down the steps and continuing along the great hall, the visitor comes upon a no less impressive columnar treatment, columns of light in ever-changing color which are the Westinghouse challenge of impression to the eye. Overhead spins the rotor of a big turbine, its thousands of shining blades flashing in the light, while near it soars a large model of a Zeppelin starting and stopping in response to words spoken into a microphone on the floor below.

Leaving it to the light and power companies to show in their exhibit the broad picture of how electricity is generated and distributed, where, by the way, it is done most admirably in an immense diorama, the manufacturers content themselves with demonstrating some of the more spectacular pieces of apparatus and showing their operation. But this does not mean contentment with little by any means. The visitor could easily spend a couple of hours prowling through the exhibits peering into the internals of mercury-arc rectifiers at the inferno of boiling and incandescent metal, pushing buttons to start and stop big motors, trundling along on a mine locomotive and going nowhere, since the machine runs on a treadmill, opening and closing switches with most satisfying roars and bursts of flame. Or, if he wishes, he can study the applications of electricity to industry and to land, marine and aerial transportation. Or, perhaps, he has a practical mind to matters directly affecting himself and wants to find out how his meter works. Obligingly, the Sangamo Electric Company joins its comprehensive display of the meter art with that which is shown in the G.E. and Westinghouse exhibits to prove to him that in comparison with the butcher's or grocer's scales or any other measuring device in commercial use the electric light meter is an instrument of absolute accuracy.

But the chief attraction in the Electrical Building, that which undoubtedly will bring many people back again and again, is the opening up of their research laboratories by the General Electric and Westinghouse companies. Here, truly, are marvels, things to set the imagination soaring and to cause jaws to drop in amazement when the visitor goes home and tells the neighbors about them. General Electric, following out the "House of Magic" idea, has set up its research display in the form of a scientific vaudeville show, giving continuous performances daily in a 200-seat auditorium in the exhibit space. Westinghouse has a different idea, places its research demonstrations along a balcony above the main exhibit so that visitors can walk along and work the experiments themselves. Let's attend a performance and then take a walk along the balcony.

The first impression of the "House of Magic" theater is that it is lighted in a most unusual manner. The illumination is that which may be in common use in a few years. It is produced from concealed sources by some ordinary and some very extraordinary lamps and gaseous tubes using neon, mercury and sodium gases. The star performers in the show are high-frequency coils, phototubes, amplifiers, stroboscope, cathode-ray oscilloscope and ultraviolet rays.

High-frequency coils are called upon to pop corn in a glass container set between two other containers filled with ice and water, to melt an ordinary saw blade without injuring a human hand placed in the same furnace, and to give other demonstrations of the effects of high-frequency oscillations on various types of materials.

Photoelectric tube demonstrations include the set-up which prevents the lighting of a candle with a match, the relay being connected to a vacuum cleaner motor mounted in a box with the tube and amplifier. A sorting machine, using black and white balls rolling down a chute, demonstrates the application of the light-sensitive device to industrial sorting and counting operation. A smoke exhauster, indicating the possibilities for the tube to be used for the control of ventilating equipment, or for giving a signal to the engineer when heavy smoke is rolling out of a chimney, is operated with cigarette smoke. In addition to showing a one- and two-way counter, the phototube is used to count the flickers in the radiation of an incandescent light on alternating current, flickers to which the human eye is not sensitive.

The Once-Over on Electrical Exhibits

It is employed, too, in the demonstrations of sound carried on a beam of light.

The cathode-ray oscillograph gives the audience a chance to see what sound looks like, while at the same time it may hear what the jagged line sounds like in the form of sound vibrations. Ultraviolet effects are produced with a mercury-vapor lamp radiating a minimum of visible light and a maximum of invisible, but harmless, ultraviolet rays directed at darkened objects, covered with fluorescent paint, that apparently create and radiate their own brilliant colors. A fever machine, Geiger counter and dental X-ray are also put through their paces for the entertainment and education of the visitors.

Sequence lighting without the use of moving contacts, shown in one of the demonstrations, is a feature which has great commercial possibilities. With a battery of reactors and associated equipment, a series of twelve or more lamps, which represent as many different circuits, are made to flash in sequence, giving the effect of a traveling wave of light.

A little musical diversion is provided by a "Thyratron" organ no bigger than a toy piano, but capable of producing sound volume equal to that of the mightiest pipe organs. A wave of the scientist-magician's wand is sufficient to open the exits when the performance is over.

On the mezzanine floor of the Westinghouse exhibit as the visitor reaches the top of the circular staircase he sees a demonstration of the most remarkable possibility now opening out before electricity, the effects of short-wave or high-frequency currents. Here is a substantial fraction of a horsepower transmitted without wires over a distance of 20 ft. or more; electric lamps which unattached to anything will burn when held in the visitor's hand; waves of radio power which create a feeling of warmth in one part of the body while not affecting the other; the invisible "death rays" which are useful in killing weevils in grain and microbes in illness; waves whose therapeutic results create artificial fever that can be regulated at will.

In the bay next to the short-wave display is an exhibit by the Westinghouse Lamp Company. There is a showcase full of the extraordinary tiny parts which make up lamps, wires of rare metals and filaments varying from the heavy bars used in airport floodlights to the almost invisible threads

General Electric

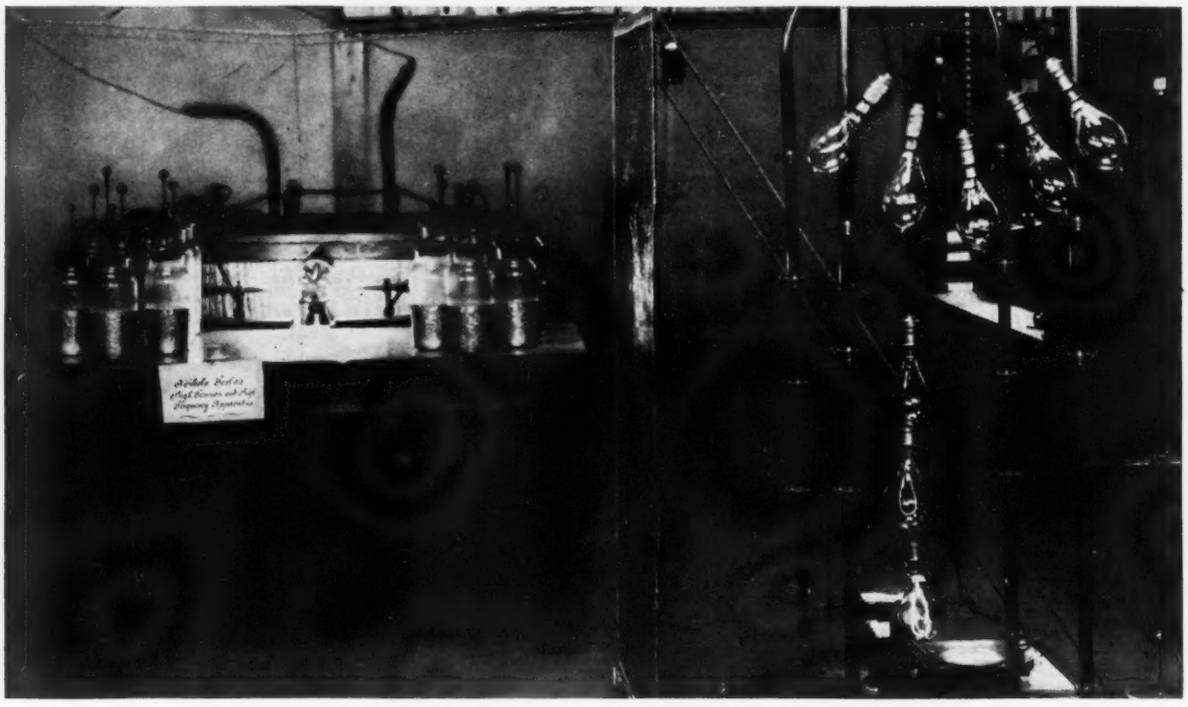
Artificial fever machine

which are necessary to make a seven-watt lamp. There is a photometer which shows how the light output of lamps is compared. On the other side next the rail is an actual X-ray outfit which the visitor can himself work to see the bones in his hand or the money in his closed purse.

In the next bay the central exhibit is a photo-electric burglar alarm. Within the window temptingly displayed is a twenty-dollar gold piece, a plate of cookies and a pair of pliers. Any visitor can have these if he can get them. Along the wall of this bay the visitor finds a photo-electric color matcher by which he can test his own sense of color. Beside this is an opacity meter which indicates on a scale the opaqueness of paper or other material submitted to it. The heart beat amplifier is the next device. The visitor holding an electrical ear to his chest will hear the sound of his heart as a loud thud and can see it appear as a wave on the surface of the oscilloscope.

The next bay overlooks the bridge passing across to the opposite side of the Electrical Building. In one corner of this central bay is the fire scanner

The Once-Over on Electrical Exhibits



High-tension and high-frequency exhibit of Nikola Tesla in 1893

which shows the possibilities of the photoelectric cell as an automatic firefighter. On the floor is a sheet-iron pit into which balls of flaming waste-paper may be thrown. Observing the pit constantly is the moving "scanner," consisting of a hose nozzle controlled by an electric eye. The moment its eye perceives a flame it stops instantly and spurts forth a jet of water which extinguishes the flame.

In this same bay will be found a magnetic strain gage, which is perhaps the most sensitive device for measuring extremely small deflections. It is able to indicate even a millionth of an inch. In the next bay the central exhibit is a card sorting machine, a development of the electric eye. It is a machine actually built for sorting out checks and bill stubs commercially and can without fail read not only the difference between Aaron and Zwingler but can readily distribute into such subdivisions of the alphabet as may be required. This central exhibit of the bay is flanked on one side by a photoelectrically controlled cabinet of the metals of the future. Inside are many samples of the new metals which are likely to have such a great effect on development—iron and aluminum in large crystals, distilled metals and the gases which have been driven from them, a rediscovery of the hardened copper of the ancients and new alloys such as conel, which retains its strength when red hot, and Hipernik, which responds to magnetism more readily than any other metal ever discovered. On a table lie long thin strips of this metal, which the visitor can pick up in his hands, touching the tips together. East and west they show no attraction whatever, but if the observer turns so that the strip points north and south their tips cling together perceptibly due to the effect of the earth's magnetic poles.

Cobalt steel is another very curious material which alone of all the metals in the world can be made to nullify the force of gravity and support its own weight in the air. On the opposite side of this bay is seen a large cobalt magnet floating unsupported which the visitor can push down and it bobs up exactly as if it was on a spring. And here is bimetal, really two metals welded together.

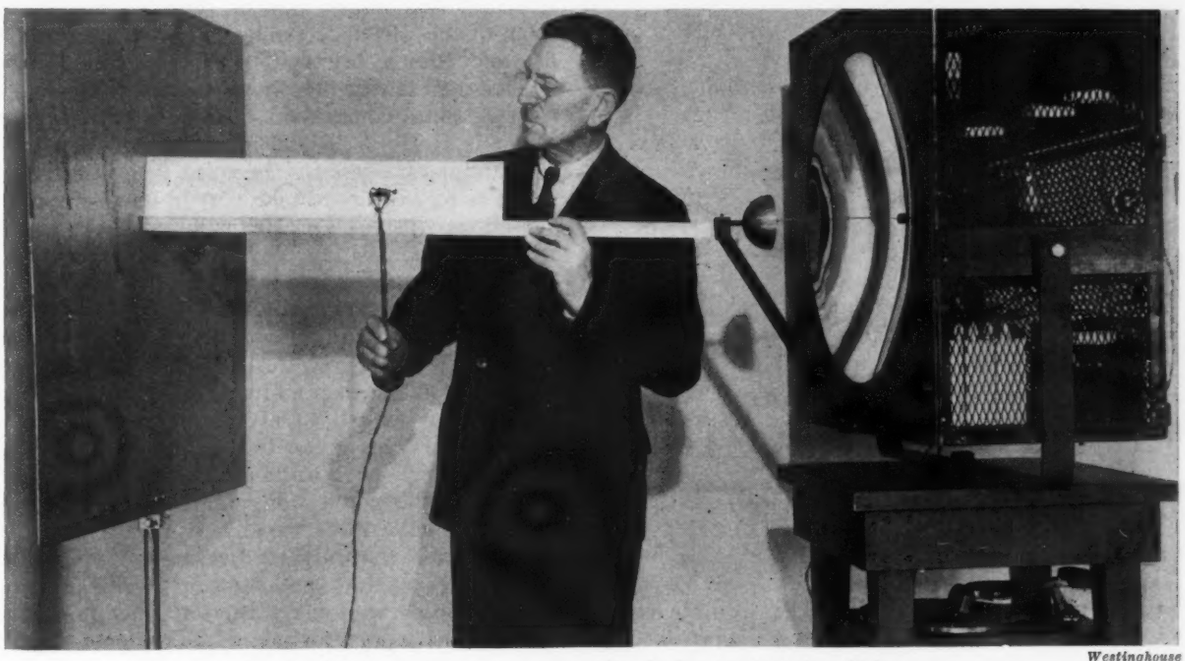
The Once-Over on Electrical Exhibits

When heated it curls. It is very widely used for the control of electrically heated apparatus. Watch its performance in the little heat engine consisting of bimetal disks on the ends of levers which fall alternately on hot and cold plates and incessantly jump from one to the other. Near by is another exhibit of bimetal peculiarities, a meter which registers an invisible ray of heat. The visitor can intercept this ray by raising a barrier whose shadow protects the meter. Immediately the pointer returns to zero. When the barrier is dropped, the long bimetal pointer of the meter feels the heat and moves the indicator.

Next door is a dark room in which is shown the stroboglow outfit, that magic pulsating red light which shows moving objects as if they were stationary, regardless of speed. Then there is the photo-voltaic cell, which manufactures electricity direct from daylight. It is a little disk no bigger than a wrist watch which, held toward the light, registers the electricity it is making on a meter. Turning away from the light the meter goes to zero. Near by is the breath relay. The visitor by merely breathing upon a sensitive plate can turn the lights in the compartment on and off.

In the next panel bay of the mezzanine are a group of the tremendous lights used for airports, the 1,000-watt landing field floodlight which makes landing safe at night, mounted on a pole of spun concrete. The visitor can turn this on and off, and beside it on the table is the airway code beacon, an odd-looking column of glass 3 ft. high which incessantly floods in green light the code word "W." Around the railing of the gallery is a series of the little colored obstacle lights which are used to mark the boundaries of an airport and lighting. And finally, above all, is the enormous 36-in. airport revolving beacon, its double beam of light sweeping around the wall exactly as do the long chain of its comrades which mark the airways of the United States.

Sated now with miracles, the visitor will feel a little relief, perhaps, to get back to things more easily comprehended. Suppose he is interested in electricity as applied to marine propulsion. If so, he will probably have to exert the full strength of his will to keep from laying plans to steal the S.S. *President Coolidge* from the Westinghouse or the S.S. *California* from the General Electric Company. These are two of the most beautiful



Westinghouse

A scientist measures a 9-cm. wave that is demonstrated at Chicago

The Once-Over on Electrical Exhibits

marine models ever built. The *President Coolidge* rides in a tank of water which concealed pumps set pouring aft at an approximate scale speed of the original. A faint haze of smoke drifts from the forward funnel. When the visitor touches the whistle button near by he is rewarded by white steam from the model whistle with the characteristic bellow of the liner responding.

Or, if the visitor is a railroad man, he stands enthralled before the models of electric locomotives. Westinghouse offers a replica of the largest electric "hog" on the Pennsylvania Railroad. This model is made to 1/16 scale. It probably represents, says Westinghouse, the utmost in the model maker's art as applied to locomotives. Its lights light, its wheels revolve and only the limitations of space prevent its being seen in operation on a track; however, it rests upon a faithful reproduction of real track and above it is the catenary overhead which would supply current to it. And General Electric parallels this display with a working model of one of the giant bipolar electric locomotives in use on the far western divisions of the Chicago, Milwaukee, St. Paul & Pacific Railroad. A novelty in the same section is the voice-controlled electric train, a toy which may be made to go forward, backward or come to a stop simply by speaking orders into a microphone or telephone transmitter.

Reproduced in miniature, the new mercury-vapor power plant of the General Electric Company shows——but this article has got to stop somewhere. There would be no room for anything else in this issue of ELECTRICAL WORLD if we went right on, as easily we might, with descriptions in detail of all the electric exhibits in the fair. As it is, we have merely glanced into the Hall of Science and spent a little time in the Electrical Building. We haven't even looked at the Travel and Transport or the General Exhibits or the Agricultural or other buildings, all of which contain much to interest people in the electrical industry. For instance, down at the south end of the grounds in Travel and Transport there is a lot to write about in the exhibit of Harnischfeger Corporation, electric welding of all kinds of refractory metals and alloys and adaptation of electric power to material handling. And we haven't spoken of the exhibits of Link-Belt, Crane Company, U. S. Steel Corporation and many others in which electricity plays an important part. Well, anyway, it was never the intention that this article should be a substitute for a visit to the fair.

Telephone speed demonstrated

Between the Centennial Exposition of 1876 and the Century of Progress Exposition lies a span of years remarkable for their advances in communication science and engineering. At the Centennial the telephone, just invented by Alexander Graham Bell, was exhibited to crowds of visitors, few of whom could imagine the wide spread of telephones which was to take place in the succeeding years or the social and economic values which the telephone was destined to confer.

In a very small space in the exposition building in 1893 there could be exhibited all the telephone equipment which had been invented up to that time. Two telephones were set up a few yards apart and with these instruments visitors could carry on conversations over a short length of line. Only the fundamental discovery had been made and only the basic inventions of mechanisms for converting speech into electric currents and for reconverting these currents into speech.

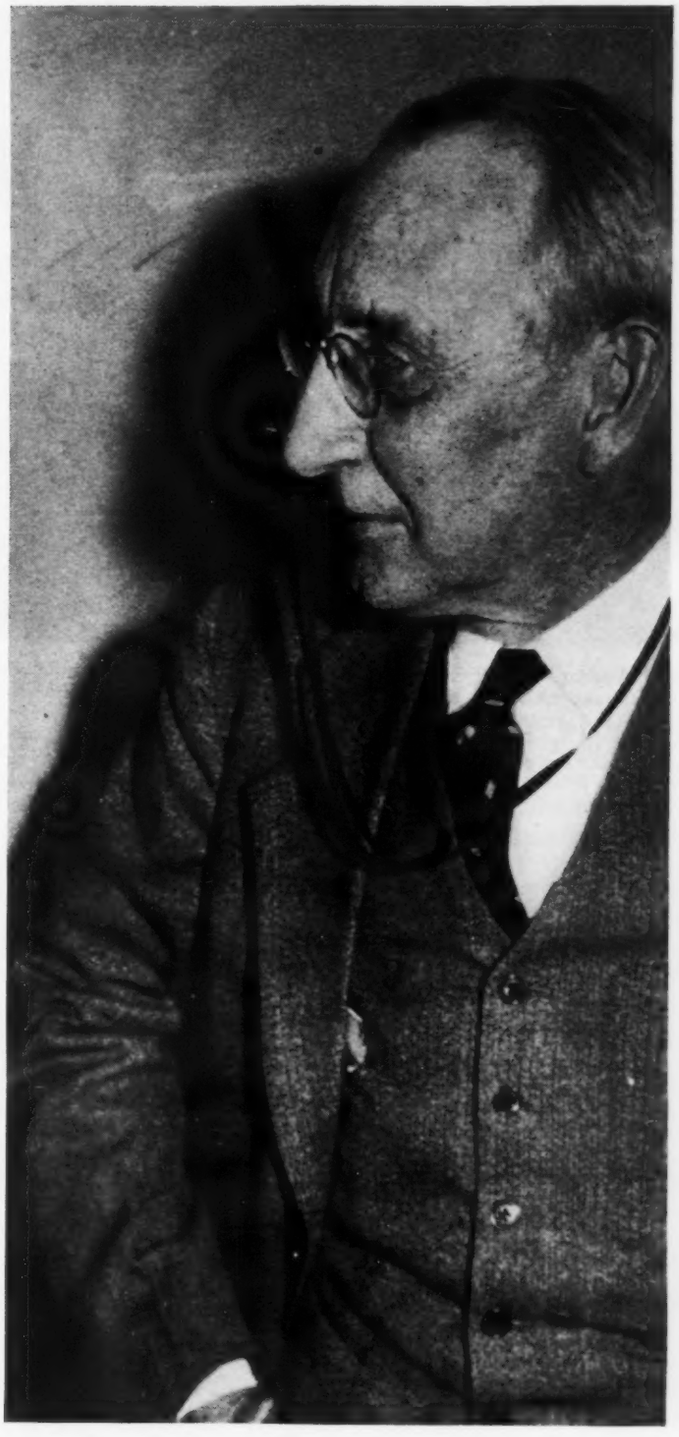
At the Century of Progress Exposition, although already accustomed to telephony, visitors will find that hours may be required merely to learn of the various communication services made possible today by the types of equipment exhibited.

That nationwide telephone service is available with prompt connections, provided the person called is ready at his telephone, and with clearness and naturalness for the voice, is demonstrated by allowing visitors to take part in telephone conversations, just as Dr. Bell allowed them to do in the 1876 exposition, except that these talks are not limited to a few yards of line but extend for miles across the country. A large map shows one or more important cities in every state of the Union. A visitor may "call" a friend in any one of them. On the map a streak of light shows the progress of his call. Only a few seconds is required, after he gives the city name and the number which he is calling, before the operator has made the connection and rung the distant telephone bell. How rapidly service is given is demonstrated not only to the single visitor who places one of the demonstration "calls" but to other visitors who may listen to the quick responses of the operators along the route and to the following conversation.

Welcome to Chicago

By Rufus C. Dawes

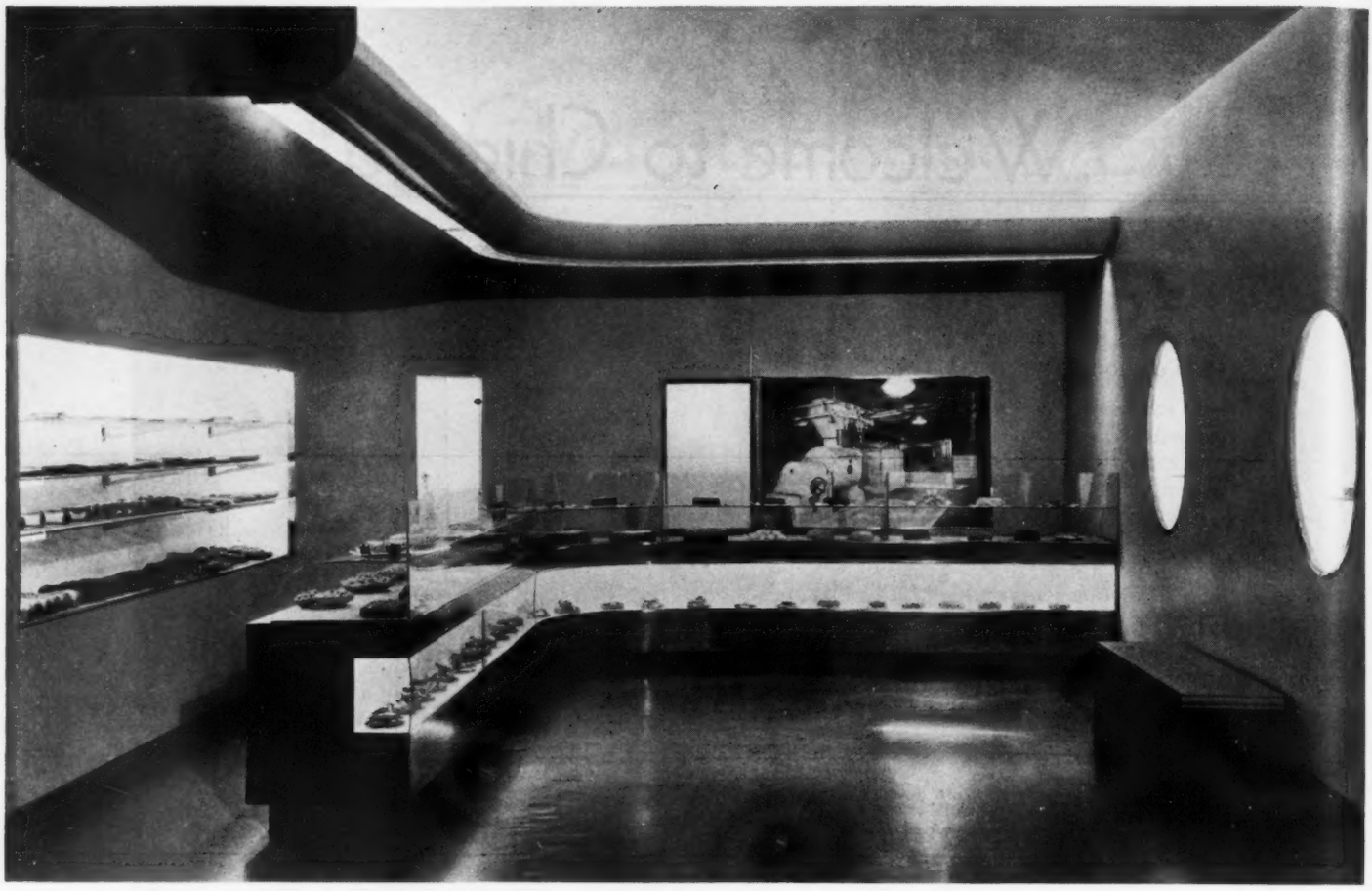
President
A Century of Progress



AS president of A Century of Progress International Exposition it will give me pleasure to welcome the delegates attending the convention of the Edison Electric Institute in Chicago, June 5 to 8, to the 1933 world's fair.

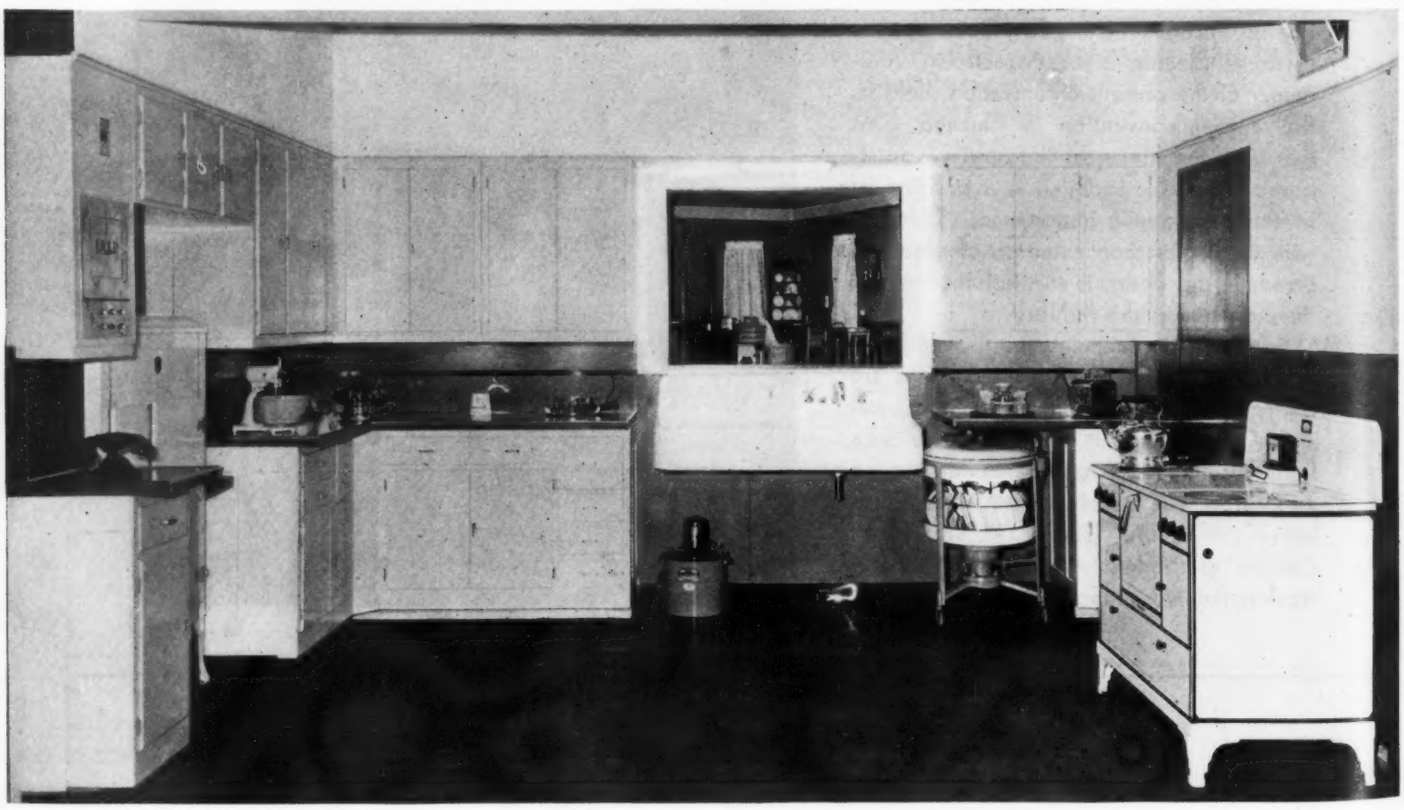
It is significant that the Edison Electric Institute is holding its first annual convention in Chicago. Nearly fifty years ago the National Electric Light Association, forerunner of the present organization, held its first annual convention in Chicago. At that time the electrical industry was in its pioneer stages. Today it is a business of immense economic importance. Chicago, with the largest concentration of electrical power in the world, is an illustration of the development of this industry.

Epochal advancements in the employment of electricity for mankind's uses are portrayed in the exhibits in the Electrical and Communications buildings. Aside from these, hundreds of other features in the exposition will be of intense interest and fascination to the visitors. A visit to A Century of Progress may well be a milestone in the lives of those who experience it.



Walk into the bakeshop—But it can't be done because the ceiling is only about 3 ft. high. This model is representative of the group of displays which show the value of electric light as a salesman in grocery stores, dress shops, beauty shops and other commercial places.

The last word in electric kitchens—In the window over the sink is framed a perspective into a kitchen of the past, a contrast that women will appreciate.



Electricity at Work

By E. W. LLOYD

Chairman
Electrical Central-Station Industry Exhibit Committee

IN "Electricity at Work," its official name, is stated the entire purpose of the exhibit of the electric light and power industry at A Century of Progress. To show people how much electricity is doing for them and how much more it can do if they will let it is the thought on which the exhibit was planned and executed. This thought was born in 1930, when the exposition itself was hardly more than a grandiose dream, taken seriously by only a small group of determined Chicagoans. But even then there were electric utility men who realized that if the dream to show a century of progress in science and in the material arts were crystallized into actuality it would represent nothing more nor less than an apotheosis of electricity. Therefore the business agencies for the production and distribution of electricity to its multifarious uses in the modern world should play a large part in the exposition; that is, should have in it an exhibit worthy of and in proportion to the importance of their industry.

The project was first contemplated as of N.E.L.A. sponsorship, but that idea—fortunately, as events developed—did not get far, and it was decided that it should be carried on as simply the voluntary effort of a group of utility companies to tell the story of electric service and utilization. How well they have told their story will be apparent to any one who walks along the 550 ft. of semi-circular mezzanine in the Electrical Building of the 1933 Chicago World's Fair.

One way of developing the exhibit would have been to show electric service in an atmosphere of luxury, to display it in so rich a setting as would make visitors wish that they might live amid such surroundings, but, recognizing the wish as vain, go away convinced that the full benefits of electricity were not for them. On the contrary, however, deliberate and consistent effort was made in working out the exhibit to divorce electric service from the idea of luxury, of expensiveness, and to show that it is for all of the people. True, beauty and good taste are included in the exhibit, but these are not necessarily elements of high cost. The impression to be taken away by visitors is, it is hoped, that the comforts, conveniences and profits of electric service are within the reach of all who want them.

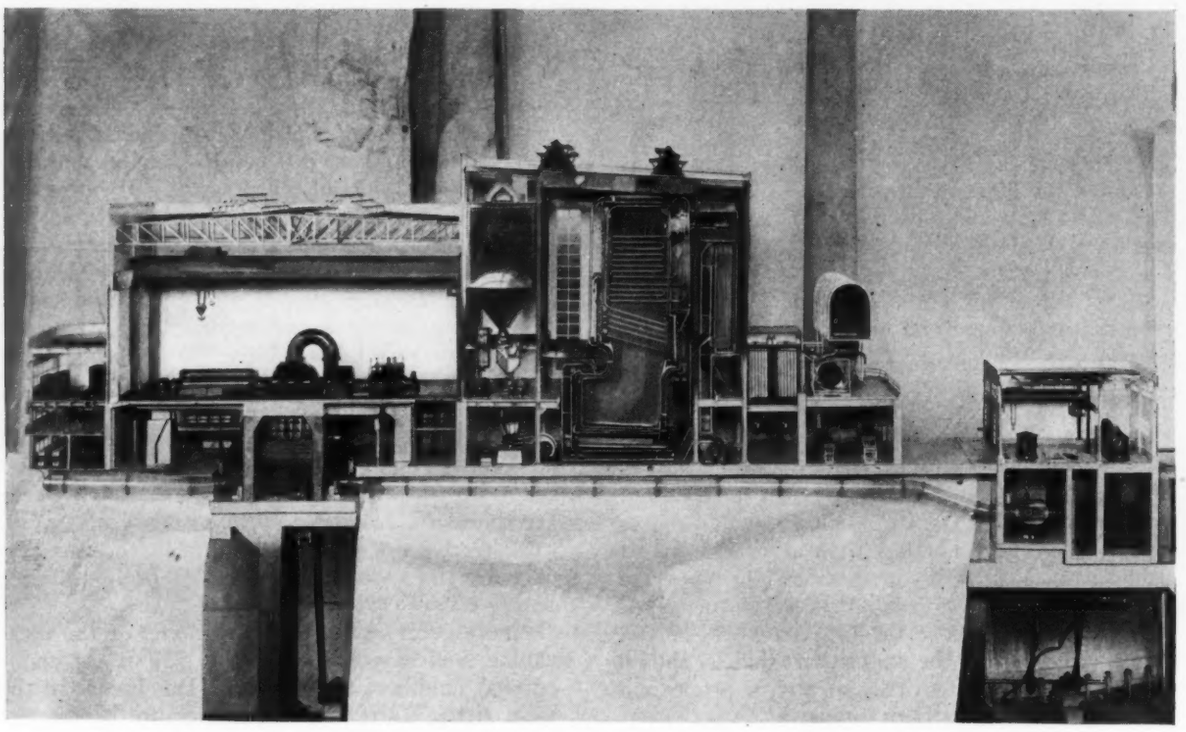
In the sense that any display to catch and fix the public attention, any advertising, any effort to impart information, is propaganda, the exhibit can be taken to be exactly that. But in the sense of propaganda as special pleading, as self-interested coloring of fact, as attack on any other ideas, the exhibit is entirely free from it. It is simply and wholly a clean-cut presentation of the physical arts of electricity supply and utilization, with emphasis upon the latter because it is of closer interest to the public at large.

Principal credit for the exhibit goes, of course, to the electric utility organizations, whose sponsorship made it possible. Yet there is a hardly less important group whose co-operation and active support and help were indispensable. These are the manufacturers, not alone those of specifically electrical equipment, but also those whose products are associated in greater or less degree with electric service application.

The exhibit covers all 8,000 sq.ft. of the mezzanine, which extends the full 550 ft. of semi-circular length of the Electrical Building. On the wall, rising 40 ft. above the entrance of the exhibit, is a huge flat figure of gleaming copper symbolizing the drawing of electricity from nature and its application to the services that man has found for it. Below the feet of this figure begins the "copper highway," a three-bar bus structure suspended from the ceiling and leading on, like the green line in the subway, from one display to another. The features of the exhibit thus first offered to the visitor are historical, showing by models in operation all of the beginnings of the electrical industry. Here are Hero's turbine, Watt's engine, Volta's experiments, Oersted's devices, Faraday's dynamo, all of the basic discoveries and inventions. But these are only the prelude to the main theme of the exhibit, which is the use of electricity in the home, in industry, business and commerce and on the farm.

There are six divisions in this utilization display. They show the uses of electricity in the home, on the farm, in commercial applications, in schools and colleges, in hospitals and public health institutions and in industry. Most of these displays consist of actual equipments in operation in full-sized installations, recourse to miniature presentations being taken only where necessary.

Electricity at Work



Coal to electricity—The translation of heat energy in coal to electricity is made plain to the non-technical mind in this model of a steam generating station.

The use of electricity in the home is demonstrated in three full-sized displays of living room, kitchen and basement. In the first are brought together all of the contributions of electricity to the modern ideas of comfort, beauty and utility in gracious home life. In the kitchen gleam the polished metal and colorful enamel of all of the portable and built-in devices that make this room the brightest and most cheerful of the modern home. Laundry, air conditioning and other utilitarian equipments are located in the basement. In all of this display of electricity in the home great care is taken not to impress the visitor with the idea that electric services are expensive and at the same time to show them in most appealing fashion; to inspire a desire for them and as well show that they are obtainable.

A modern farmstead, complete with all buildings in model size, gives an over-all picture of farm electrification. The details of this broad picture are filled in with illuminated displays of actual equipments of the many types and forms that have been developed for farm use, more than thirty of them. Electrical uses in plant husbandry, such as soil heating and irradiation, are presented, in collaboration with Purdue University, in a full-sized greenhouse.

Electricity as a business accelerator and a profit maker is emphasized in the commercial displays. All are built on the efficiency of electricity, particularly electric light, as a salesman. There are five of these demonstrations, a butcher shop, grocery store, bakery shop and restaurant, dress shop and beauty parlor. The latest and most modern ideas in appliances for specific purposes are incorporated in these displays. They are models, but of sufficient size to be more than simply miniatures, and their details, such, for instance, as every conceivable cooking utensil that may be used in a modern quick service restaurant, have been executed with so exact fidelity as to excite incredulous admiration that they are mere simulations.

Power applications are sufficiently well known and appreciated as to allow that aspect of electric-

ity in industry to be overshadowed in the exhibit by new and later developments. Of these the most significant progress is the application of electric heat.

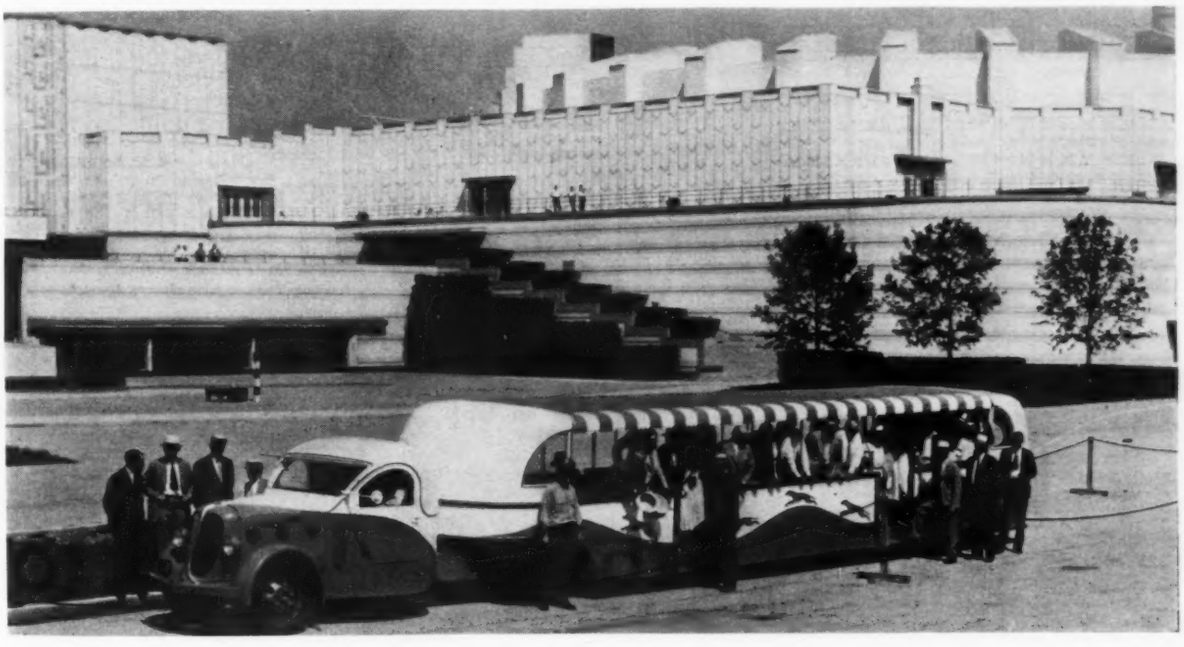
The announcements that come so frequently in these days of new discoveries and techniques in electrometallurgy indicate the rapidly growing importance of this field. For this reason the exhibit pays large attention to electric furnaces for melting, heat treating and annealing metals. Heat for process and other uses, such as welding of large steel sections, is also adequately presented in the display. Although power applications, such as might be represented, for instance, by a large display of motor types, are not dominant in the industrial display, the control of power applications, making use of phototube and other electronic devices, is not by any means neglected.

Great diorama a feature

The most spectacular thing in the entire exhibit is the largest diorama ever made, of museum caliber, 90 ft. long, that depicts the production, transmission, distribution and utilization of electricity. This diorama took two years to design and construct. It is a marvelous piece of work. Generation of energy in high- and low-head water-power plants and in a steam station are included in it in operating models. Water rushes through the hydro turbines, colored liquids show the flow of water and steam through the boilers and piping systems, generators spin.

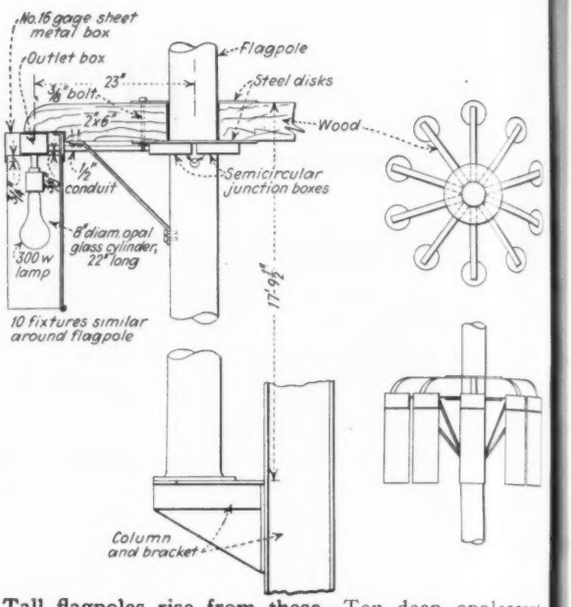
From the hydro plant transmission lines stride over the countryside, tying in with the steam plant and with substations to furnish energy for distribution systems in city and country. A model of a large city with skyscrapers in the business district, lines of residence streets and a most convincing industrial area occupies one end of the diorama. Over the whole scene plays the movement of life and activity. Alternations of light and darkness simulate day and night and street lights and lights in buildings go on and off. By seeing as a whole this complete picture of electricity generation, distribution and use the onlooker must get a clear conception of the parts and functions of an electric service system.

But there is little use in trying to give an exhaustive description of this great exhibit. It would be only a weariness of words. Let it suffice here to say that the exhibit is a credit to the industry it represents. This is not the complacent assertion of the committee in charge. It is the dictum of those who have seen the exhibit.

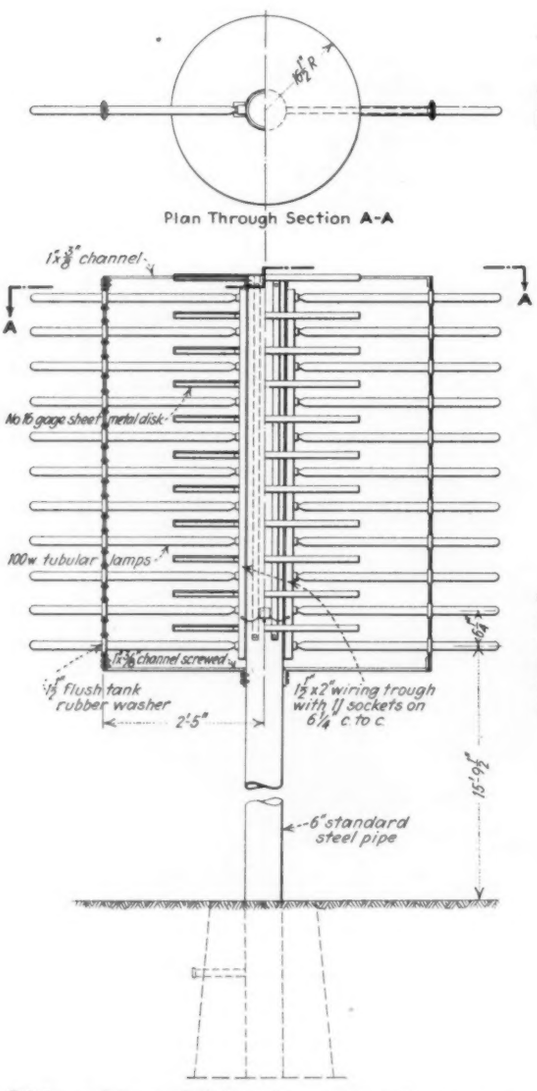


Special Types of Standards Used for Outdoor Lighting

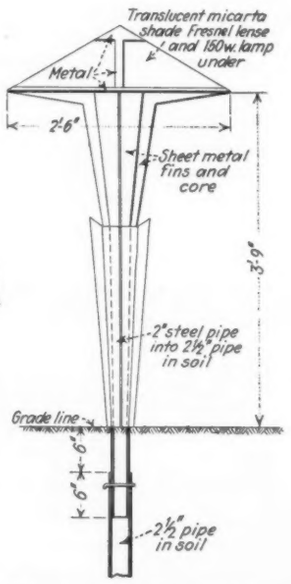
PROBABLY the practical art of street lighting will not be profoundly influenced by the designs for outdoor standards and fixtures used at A Century of Progress. But as exemplifying the possibilities of electric lighting for novel and striking effects, these designs are important. Amusement areas and parks might profitably borrow the ideas shown here. These sketches do not include all of the special designs that will be used at the fair. The necessary simplification of the drawings to obtain clarity of printed reproduction prevents showing all construction details, such as the use of spot welding, of standard outlet troughs, of pre-fabricated unit parts and other means by which, in comparison with the effects produced, costs are kept extremely low.



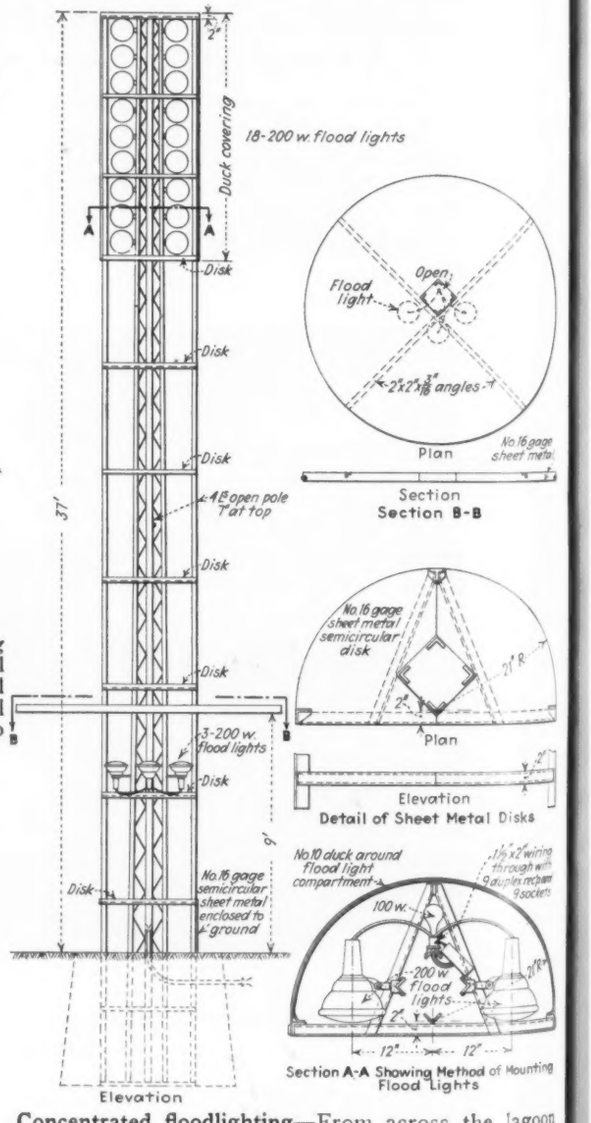
Tall flagpoles rise from these—Ten deep opalescent cylinders are arranged circularly about each of the two flagpoles in front of the U. S. Government Building.



Disks and bars of light—About 40 of these standards will line the long avenue from the north entrance up to the Hall of Science.

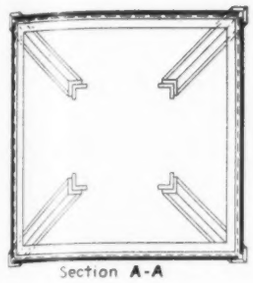


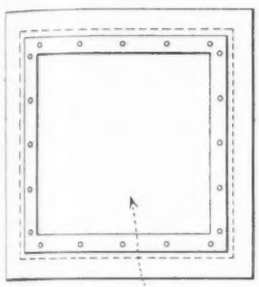
"Mushroom" lights—Along the paths and roadways all through the grounds will be located these ground lights, translucent on top to add to the display.

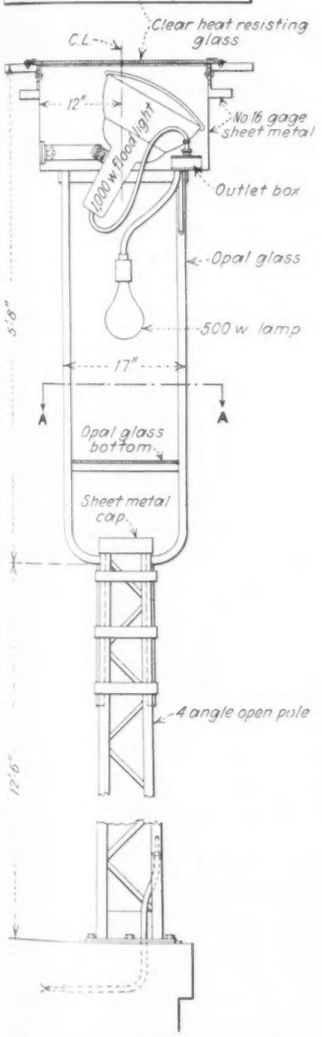


Concentrated floodlighting—From across the lagoon the fronts of the U. S. Government, Agricultural and Electrical Buildings, illuminated by 37 of these standards, will reflect their brilliant colors in the water.

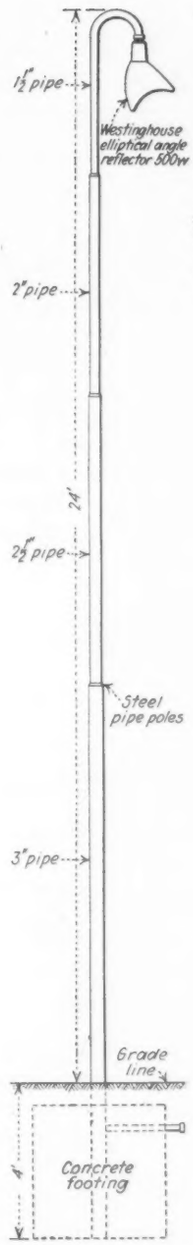
Electrical World, May 27, 1933



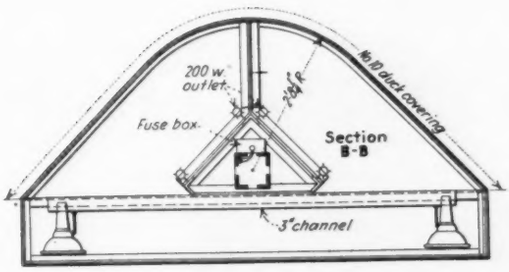


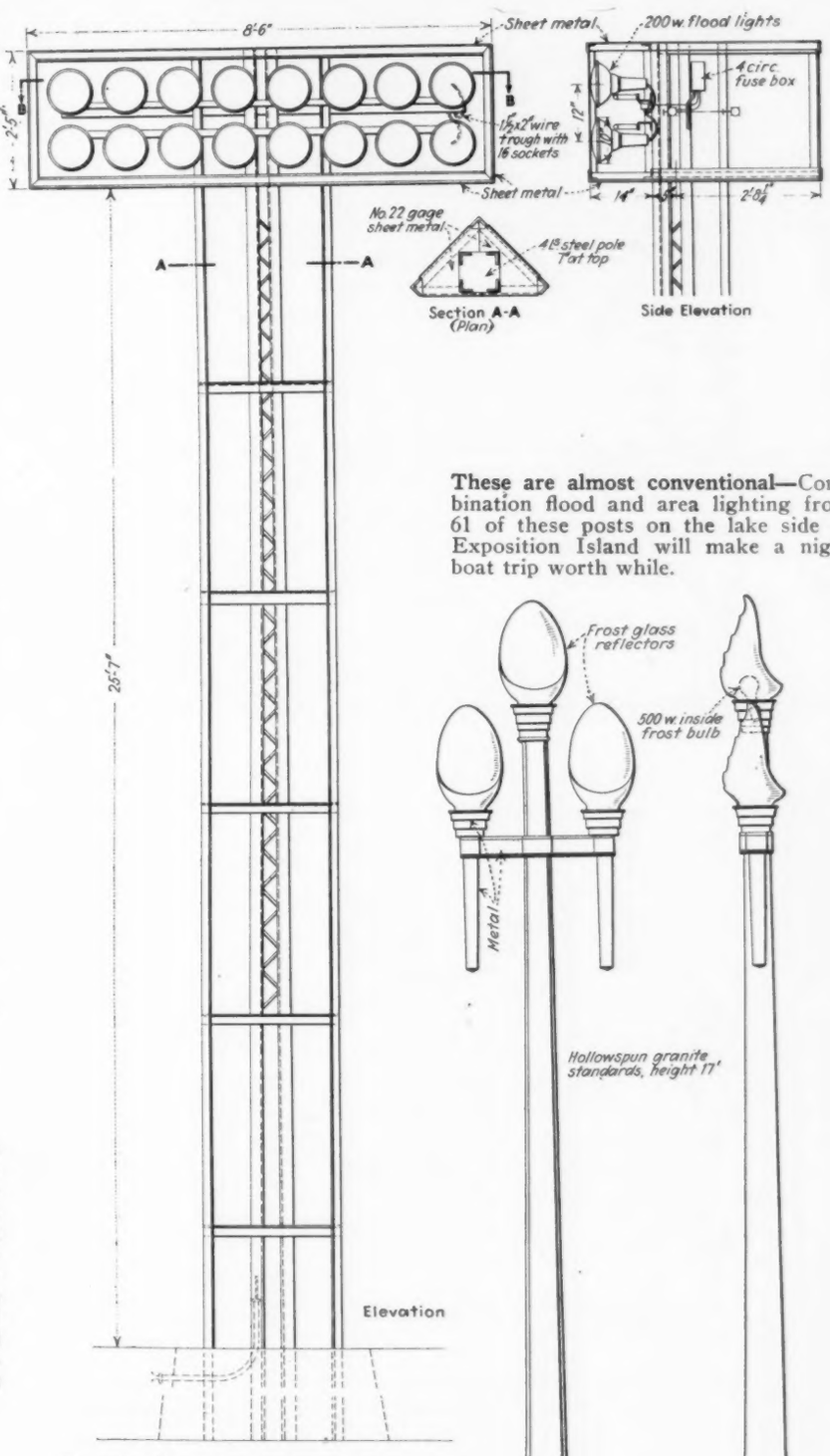


Translucent torches — The golden pylons of the Electrical Building watergate will gleam brightly in the light from four of these units.



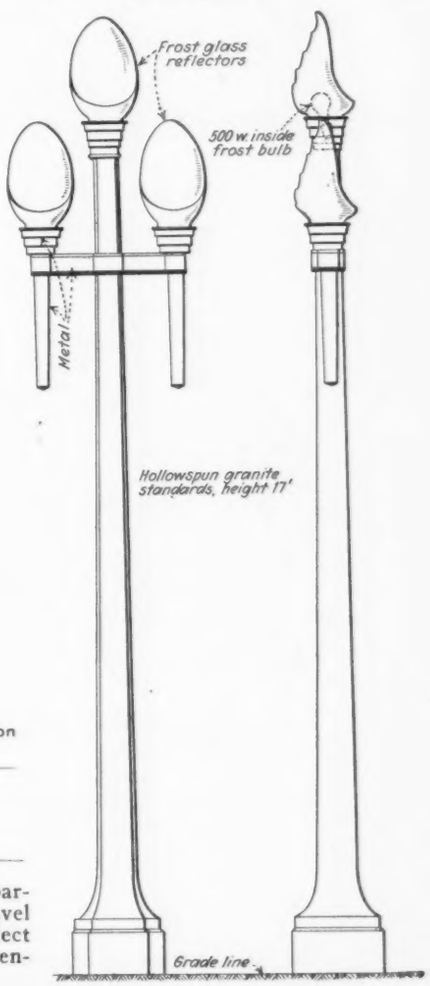
Purely utilitarian —The most striking feature of the fair will be color, every shade and hue on the exteriors of the buildings. These bands and masses of color will stand out at night illuminated by these units.

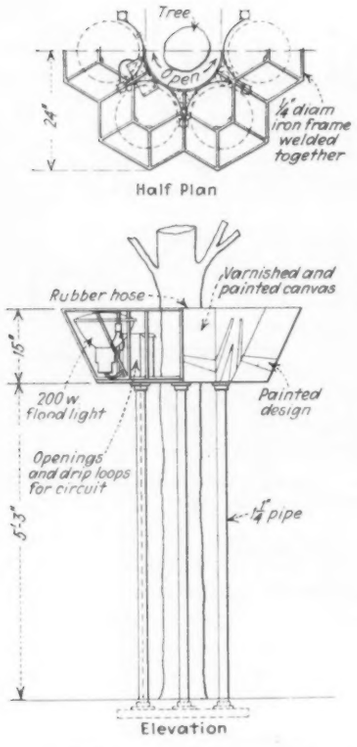


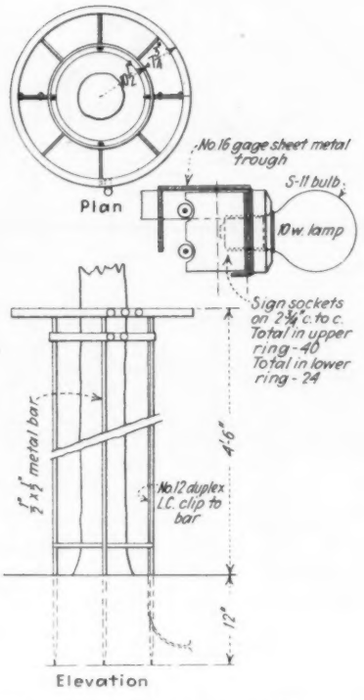


Floodlighting lengthwise—The apparently interminable length of the Travel and Transport Building will reflect back its colors in the light from seventeen of these units.

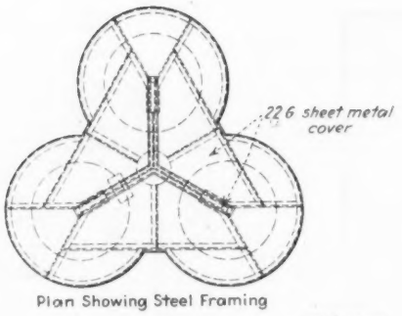
These are almost conventional—Combination flood and area lighting from 61 of these posts on the lake side of Exposition Island will make a night boat trip worth while.

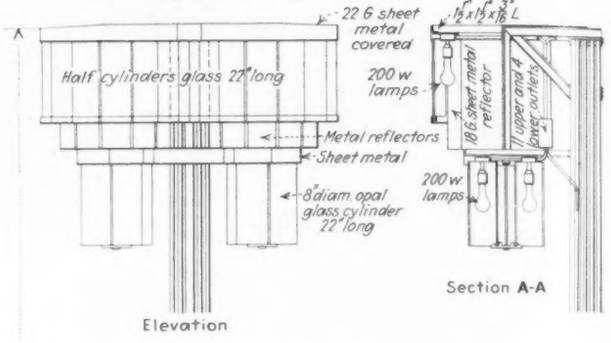


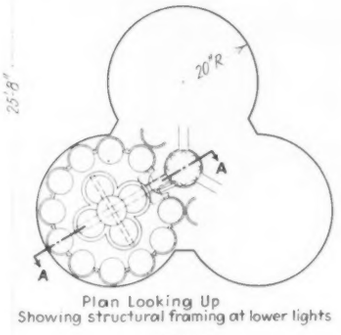


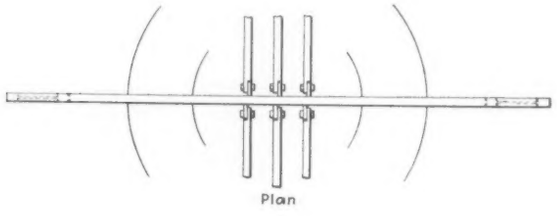

No 16 gage sheet metal trough
Plan
S-11 bulb
10 w lamp
Sign sockets on 2¾" c. to c. Total in upper ring - 40 Total in lower ring - 24
1" x ⅛" metal bar
4'-6"
No 12 duplex I.C. clip to bar
12"
Elevation

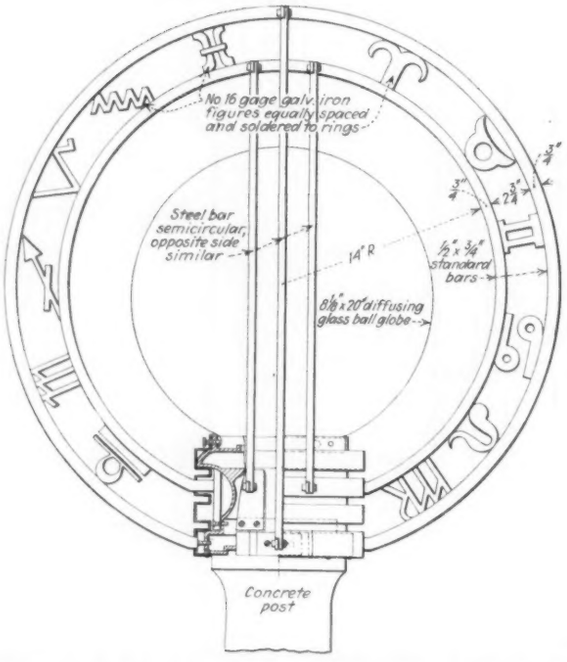
Foliage will gleam—Many of the trees in the exposition grounds will become objects of beauty by night as well as by day in the light of these units.



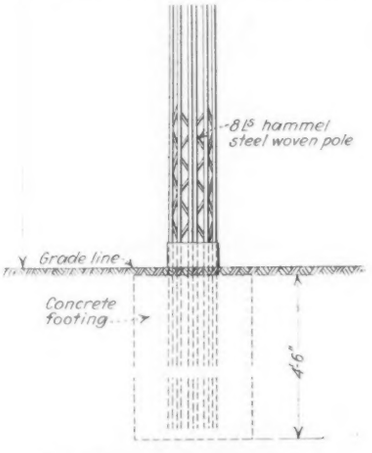




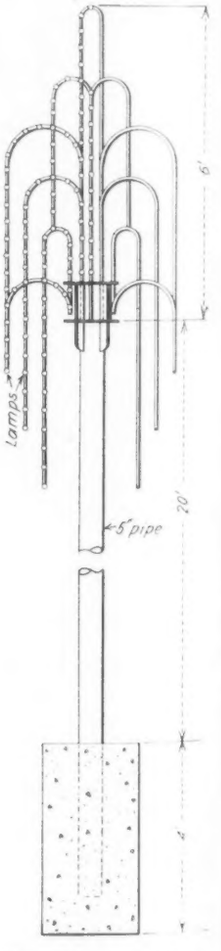



No 16 gage galv. iron figures equally spaced and soldered to rings
Steel bar semicircular, opposite side similar
14" R
½" x ¾" standard bars
8 19/32" x 20" diffusing glass ball globe
Concrete post

The way to the stars—Zodiac capitals will top the lighting standards lining the road to the Adler planetarium.



Clusters of opalescence—Two of the courts of the General Exhibits Building will glow in the light of these tall standards.

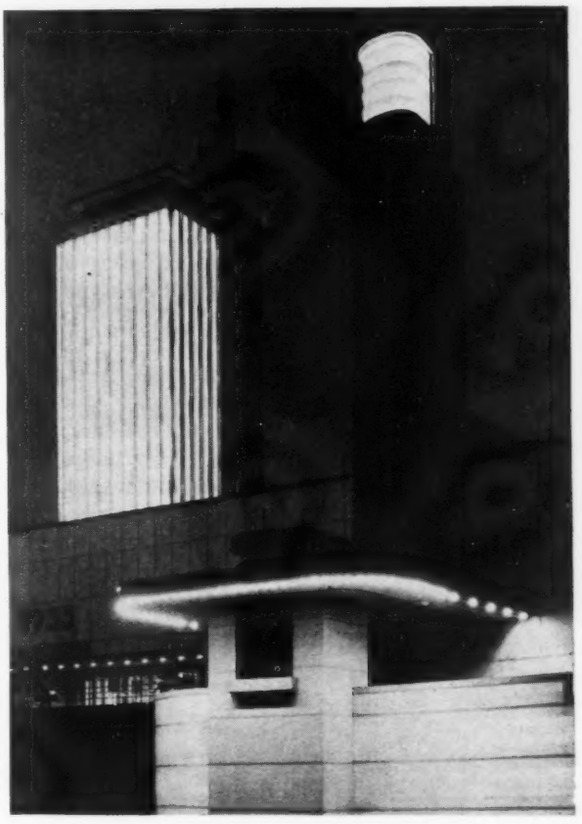


Fountain effect—Ten of these units will illuminate the Court of States.

Lighting an Exposition

Mr. Ryan, known for his work in the lighting of the San Francisco and other expositions, is the chief of a group of lighting specialists from the Westinghouse and General Electric companies who have jointly undertaken the illumination of A Century of Progress. Associated with him are C. J. Stahl, who did the lighting at the recent exposition in Barcelona, Spain; H. E. Mahan and J. W. Shaffer.

By W. d'ARCY RYAN



EXTERIOR illumination at A Century of Progress exposition may be summarily described as decorative floodlighting in static white light—assuming that we consider the warm yellowish white radiation of "Mazda" lamps as relatively white light. The exposition itself is a symphony in color, its many buildings being painted in brilliant hues. The extensive use of colored light, therefore, could have been little more than a discordant note in the general scheme of things. In justice to the possibilities which might have been offered, however, it should be added that the expense of introducing mobile color on so large a scale would have been prohibitive.

In formulating the scheme and scope there were several governing factors to be taken into consideration. Both initial cost and operating expense were particularly important because of the general economic situation. There was also the matter of average vista range, which naturally calls for greater foot-candle intensity with increased distance from which the buildings are to be viewed. The coefficient of reflection of colors used on the buildings and the atmospheric conditions peculiar to the Chicago lake front were also of prime importance to the decision governing the intensities to be used.

The design of lighting standards for floodlighting and general illumination was keyed to the general architectural scheme of the exposition—essentially a blending of the modernistic with the futuristic. Ordinarily, exposition lighting is designed primarily to emphasize the carnival spirit, and the use of lighting fixtures which might best be described as electrical jewelry is prominent. This type of lighting can be done extensively when the exposition buildings are of a classical order, but such heavy ornamentation would be out of place in the modernistic or futuristic composition this exposition represents.

The lack of embellishments and the massive effects of expansive windowless walls which characterize A Century of Progress are emphasized by the lighting. While modernistic lighting equipment has been used for exterior lighting before, it has not been very efficient, and for this reason it may be said that the Century of Progress lighting differs widely from anything that has been done previously. By leaning more toward the utilitarian than the æsthetic, lower light costs —more foot-candles per dollar—have been achieved.

Some difficulties were presented by the many

different levels from which visitors to the exposition might view the lighting. The possibility of the simple use of floodlighting projectors as they are generally applied to exterior lighting was eliminated by building construction which would allow observers to look directly into the light sources. To rid the lighting system entirely of this somewhat objectionable feature would have been to sacrifice the broad vistas desired, so the general scheme was necessarily planned to present the greatest beauty to the greatest number of people.

Special standards designed

A result of the general plan has been the design of a group of unique lighting standards that strike a new and interesting, if not unanimously indorsed, note in lighting practice. No attempt has been made at the complete concealment of the structural elements, nor are these elements disguised to confuse the observer as to their purpose. The tenets of good lighting are perhaps more easily followed in designs of this kind than in the more conventional lighting standards. The light sources themselves are screened and softened where desired or reduced to an unobjectionable intensity, but the bold simplicity of construction is preserved. Although a detailed description of the entire group of standards is too lengthy for this article, the units serving to illuminate the lower façades of the exhibit buildings typify the floodlighting standards used at several locations throughout the grounds. Within the pocket at the top of this unit are housed a group of 200-watt floodlights, each of which may be independently directed. The group thus provides the degree of uniformity of illumination required for the building façade. The sides of the pocket are formed of treated duck, stretched over the curved steel frame, and painted in solid colors. Illuminated from within by inside-frosted lamps, it presents the appearance of stained glass.

Illumination of the important façades of many of the exposition buildings is accomplished with lighting standards designed on this general theme. Relief lighting is provided by floodlights or gaseous tubes located to add emphasis by color or gradation of intensity. As noted before, color has been used sparingly to preserve the general architectural and decorative scheme which might easily be shrouded in artificial effects of trick lighting.

At least 3,000 kw. of lighting equipment—incandescent lamps, arc searchlights and gaseous tubes—was installed by the exposition, and exhibitors who have erected special buildings, as well as the scores of concessionnaires, have added to the outdoor lighting scene. More than 15,000 incandescent lamps, ranging in size from 10 to 3,000 watts; 24 36-in. arc searchlights, 72 24-in. incandescent searchlights and thousands of feet of neon and mercury vapor tubes are employed to produce the effects.

A variety of forms of lighting standards provide the illumination for the roadways throughout the exposition grounds. One of the units used for this purpose is illustrated. A 30-in., 100-watt vacuum tubular "Mazda" lamp is the light source, each standard being equipped with 22 such lamps. This is the first application of a lamp of this construction for outdoor illumination.

The lighting treatment accorded the courts formed by various groups of buildings takes its cue from the architecture and landscaping. Shower standards provide the general illumination of the States group court. Shower-like scrolls originate at the top of a 20-ft. pole and support 323 15-watt flame tint lamps on approximately 4-in. centers—a total of 4.85 kw. per standard.

Supplementing the roadway and courts lighting, occasional trees are illuminated by floodlights concealed in tree boxes around the trunks. From these projectors clear light is directed on the foliage to emphasize natural beauties. For paths and gardens in particular, a special standard, mushroom-like in design, has been developed. These units create attractive spots of light and color throughout the grounds and provide the utility light for minor roads and pathways as well as for gardens. The stem of the mushroom, a little less than 4 ft. long, is formed of sheet metal supported from a pipe core. The top or canopy is sheet micarta, sufficiently thin to be translucent. A variety of colors is used. The light source is a 150-watt clear "Mazda" lamp inside a refractor which distributes the light flux at angles approaching the horizontal, thus obtaining the maximum spread consistent with adequate screening.

The spectacular lighting features are illuminated fountains, arc and incandescent searchlight effects, and a hot-cathode mercury-neon pylon.

In reality, two distinct expositions connected by an amusement area and groups of miscellaneous

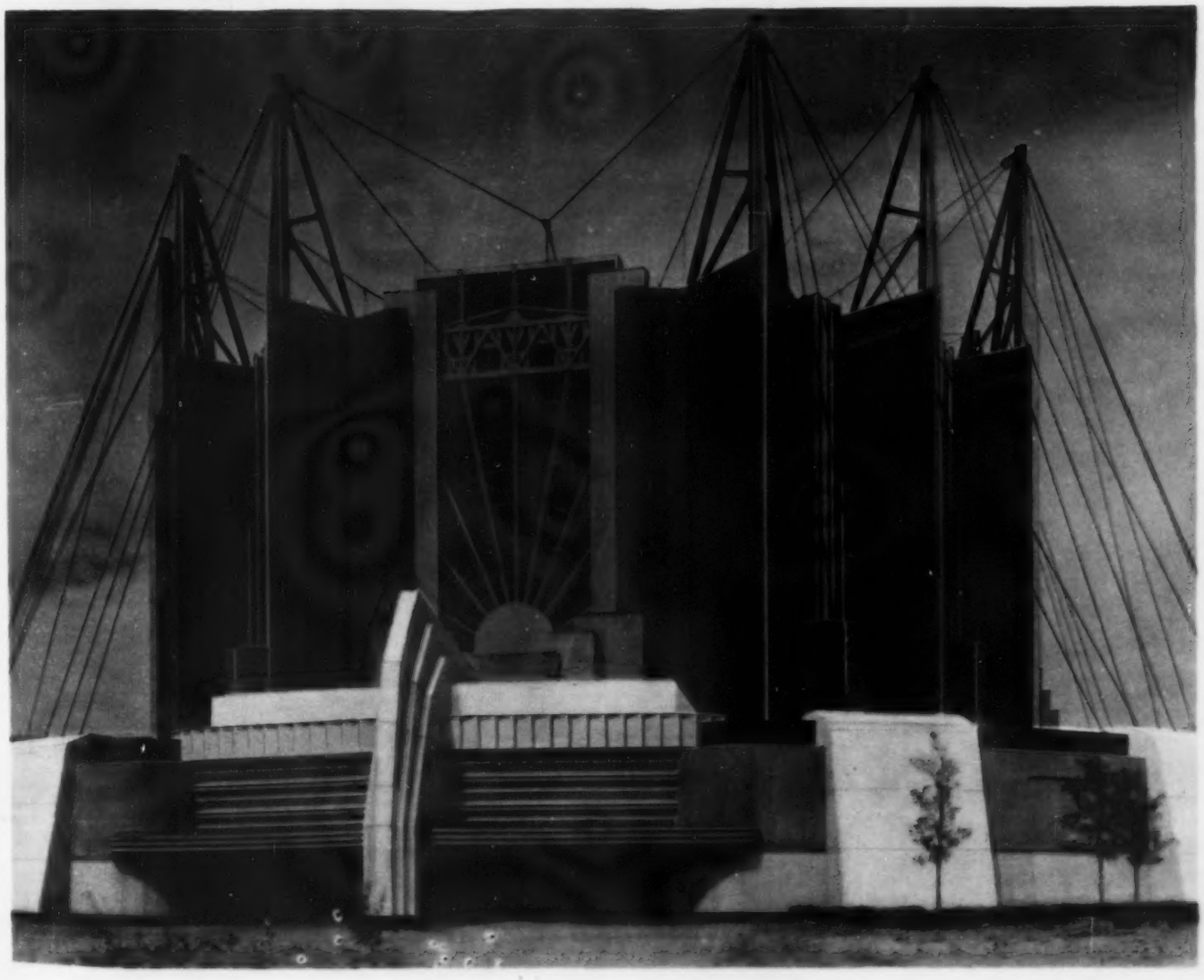
(Please turn to page 697)

A CENTURY OF PROGRESS

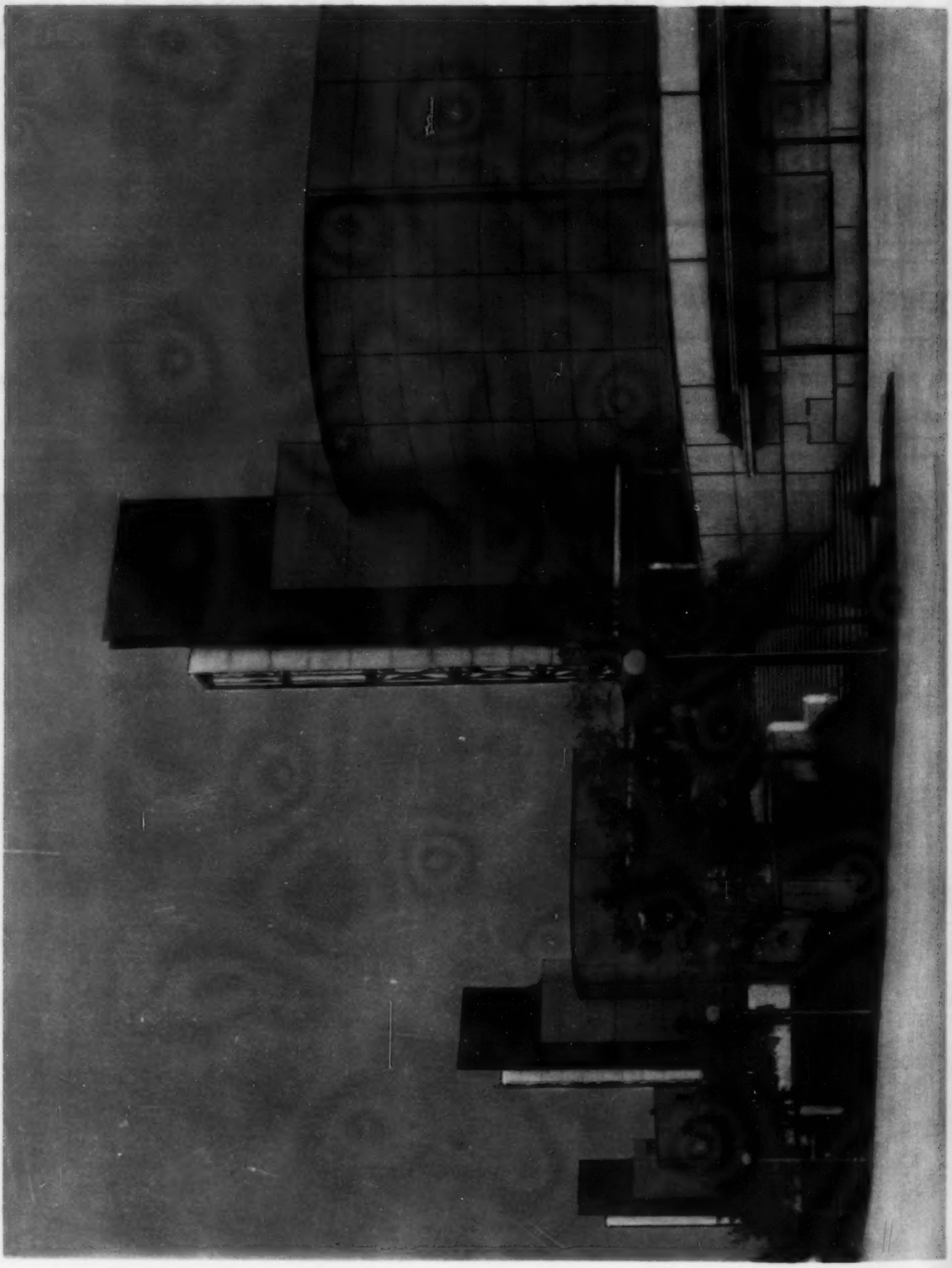
1833-1933

CHICAGO'S DREAM CITY DEDICATED TO SCIENCE AND ENGINEERING

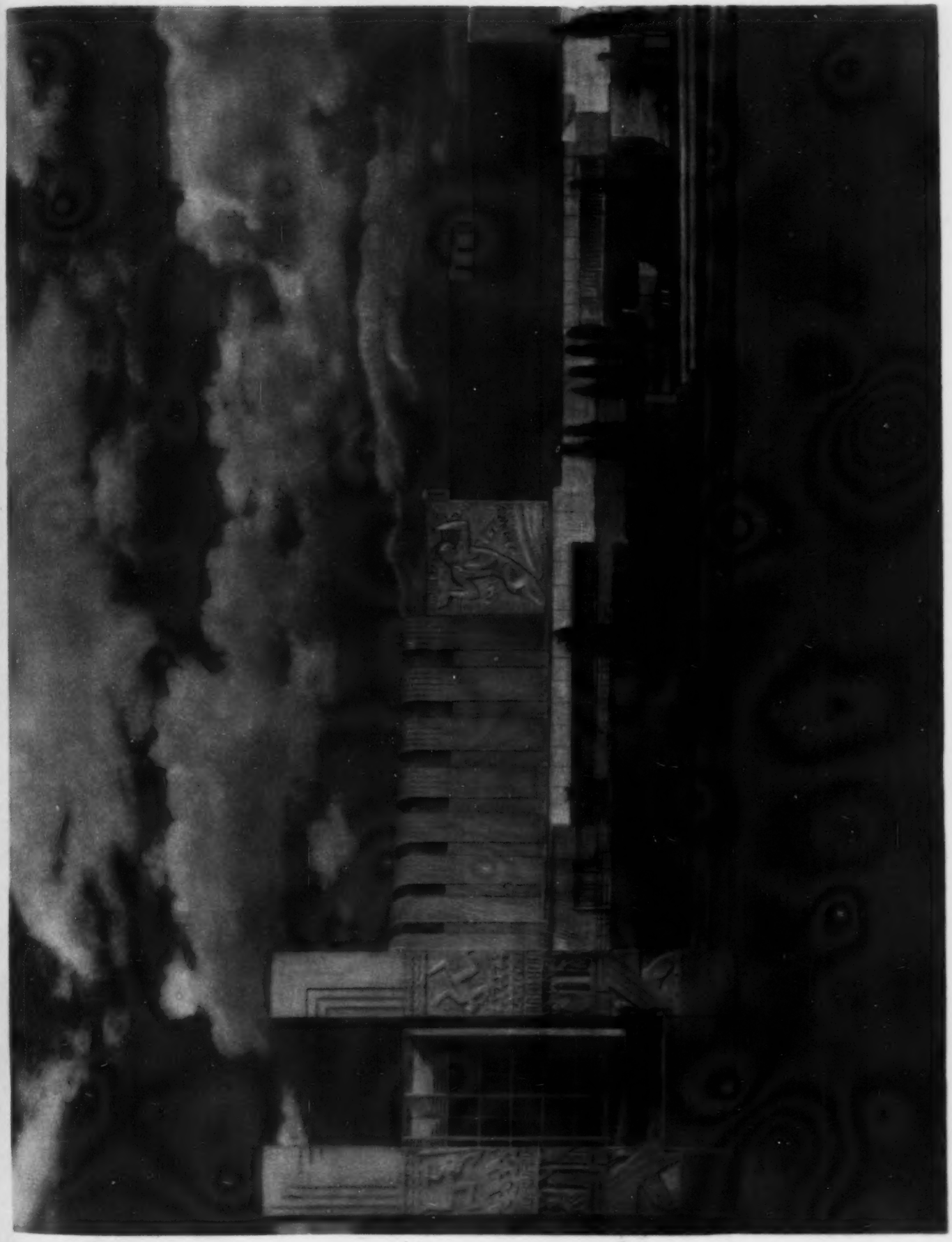
A PALETTE OF TWENTY-FIVE COLORS WILL BRING COLOR-CONSCIOUSNESS TO MILLIONS



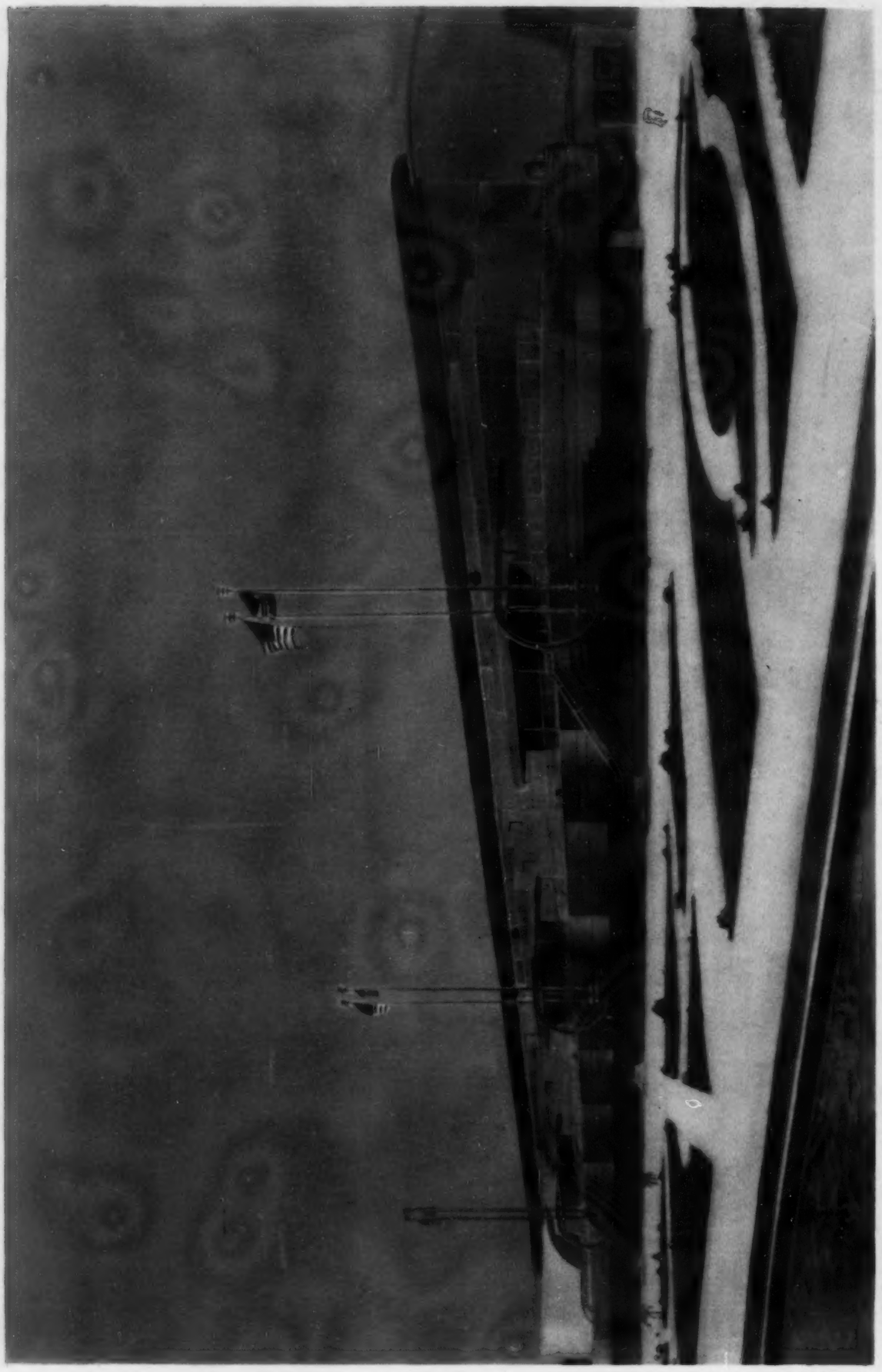
THE STORY OF TRANSPORTATION—A UNIQUE SUSPENDED DOME



INDUSTRY TELLS ITS STORY IN THE GENERAL EXHIBITS BUILDING



ELECTRICITY AT WORK—ELECTRICAL BUILDING

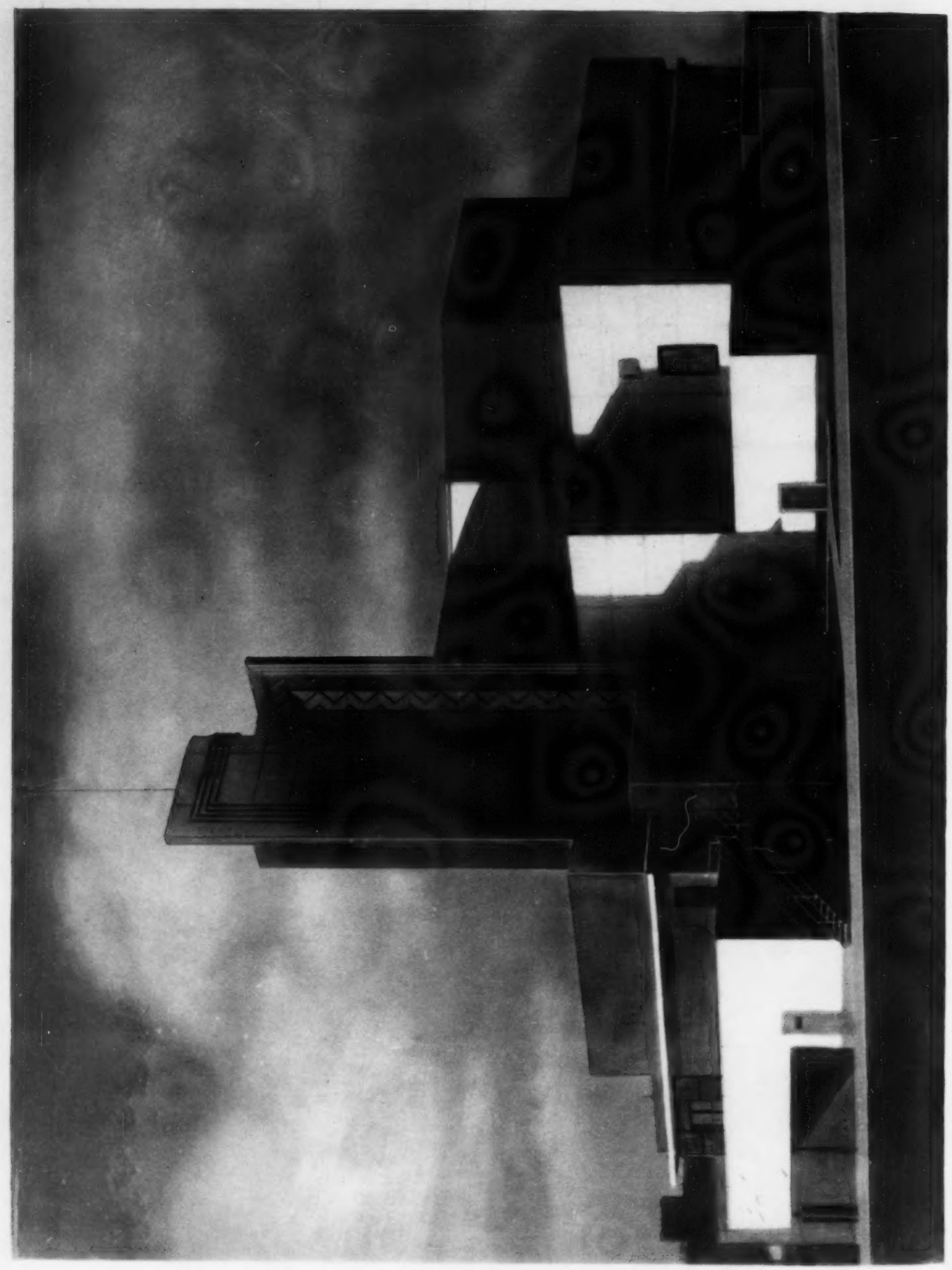


SCIENCE AND ENGINEERING IN AGRICULTURE

THE CARILLON TOWER OF THE HALL OF SCIENCE

THE SEAT OF ADMINISTRATION AT THE CENTURY OF PROGRESS

THE THREE PYLONS OF GOVERNMENT—LEGISLATIVE, EXECUTIVE AND JUDICIAL



CENTURY DAIRY EXHIBITS MODERN DAIRYING

Photographs Courtesy of Kaufmann-Fabry

Lighting an Exposition

participants are created by the shape and layout of the exposition grounds. The most brilliant lighting effect was therefore designed to form a connecting link between the two sections. The spectacular scintillator accomplishes this by powerful light beams which seem to form a canopy over the entire area. Located on the shore of Lake Michigan near the southern extremity of the grounds, the scintillator consists of 24 36-in. arc searchlights, arranged on a two-step platform, twelve searchlights on each step. Drawing 125 amp. each, the 24 searchlights have a total output of approximately 1,440,000,000 cp. The scintillator is handled by a group of trained operators, who change the colors of the light beams by the use of gelatin screens. Mounted on swivel and trunnion bases, the directions of the beams are also changed manually. The changes are made in cadence, the operators acting under the direction of a captain in charge.

Searchlight beams over exposition

In their initial position the searchlight beams form an aurora over the entire exposition, but at a change signal may be individually revolved, focused down, expanded or given any other of many possible forms and colors to create a variety of interesting and beautiful drills. Supplementing the scintillator drills, perforated pipe structures, emitting jets of steam, form huge fans, delicate feathers, fantastic plumes and fiery pinwheels, on which the multi-colored beams of the searchlight battery are directed. Fireworks and smoke bombs exploded high in the air also provide mediums upon which the beams are directed to create weird and strikingly beautiful effects high above the ground.

Incandescent searchlights, size 24 in. and 36 in., are used, the former at points of vantage throughout the grounds and the latter to form an aurora over the court of the Electrical Building. The 24-in. searchlights are equipped with 1,500-watt G-48 floodlighting lamps and are used primarily to create highlights and shadows and to supplement the floodlighting on some of the buildings. For this purpose two groups of 25 searchlights each are located on the Sky Ride towers 600 ft. above the ground.

The 36-in. incandescent searchlights are a part of the illumination system installed for the court of the Electrical Building, being used with an unusual combination which includes an electric fountain of unique design and mercury-vapor tubes that present the appearance of a waterfall over the curved surfaces at the rear of the semicircular court. Seventeen of these searchlights, each equipped with a 32-volt, 3-kw. lamp, are mounted on the roof to form an aurora over the building. Adjusted so that their beams intersect over the axis of the fountain to form a brilliant silver fan high in the air, the light sources themselves are practically invisible. In the center of the court an illuminated reflecting fountain serves the dual purpose of creating an interesting spectacle of illuminated water and of reflecting this light to provide soft, subdued illumination in that area.

This lighted fountain consists of three concentric step basins within an outer pool approximately 70 ft. in diameter. At each of the four levels thus formed a ring of small water jets arises, each illuminated in a different color. Both the illumination and water effects are constant. From the center, supports rise more than 50 ft. in the air to hold an inverted cone or canopy of polished metal, the stippled surface of which reflects colored light from the water to create a rippling mat of mobile color. A total of 42 kw. of lighting equipment is apportioned among the four colors—red, amber, green, and blue—with 135 floodlighting projectors. A motor-driven centrifugal pump located in the base of the fountain circulates 1,200 gal. of water per minute through the 496 jets.

Three electric fountains have been installed in the South Lagoon, just off the east shore and north of the 23d Street bridge. They are arranged approximately 150 ft. apart in a straight line. Each fountain delivers 1,200 gal. of water per minute through 507 water jets, sprays and nozzles, and the two outer fountains are constantly illuminated with clear light. In the center fountain 70 underwater projectors, equipped with red, green, blue, and amber lenses, and controlled by a "Thyratron"-reactor set, provide harmonious gradations of mobile color. The water effects are changeable, all three fountains passing through the same cycle in synchronism. Regulated by a central controller operating electric thrustor valves, the eight distinct water effects are held over for a period of 75 seconds each. The entire cycle of water and color changes, which is climaxed by a display of

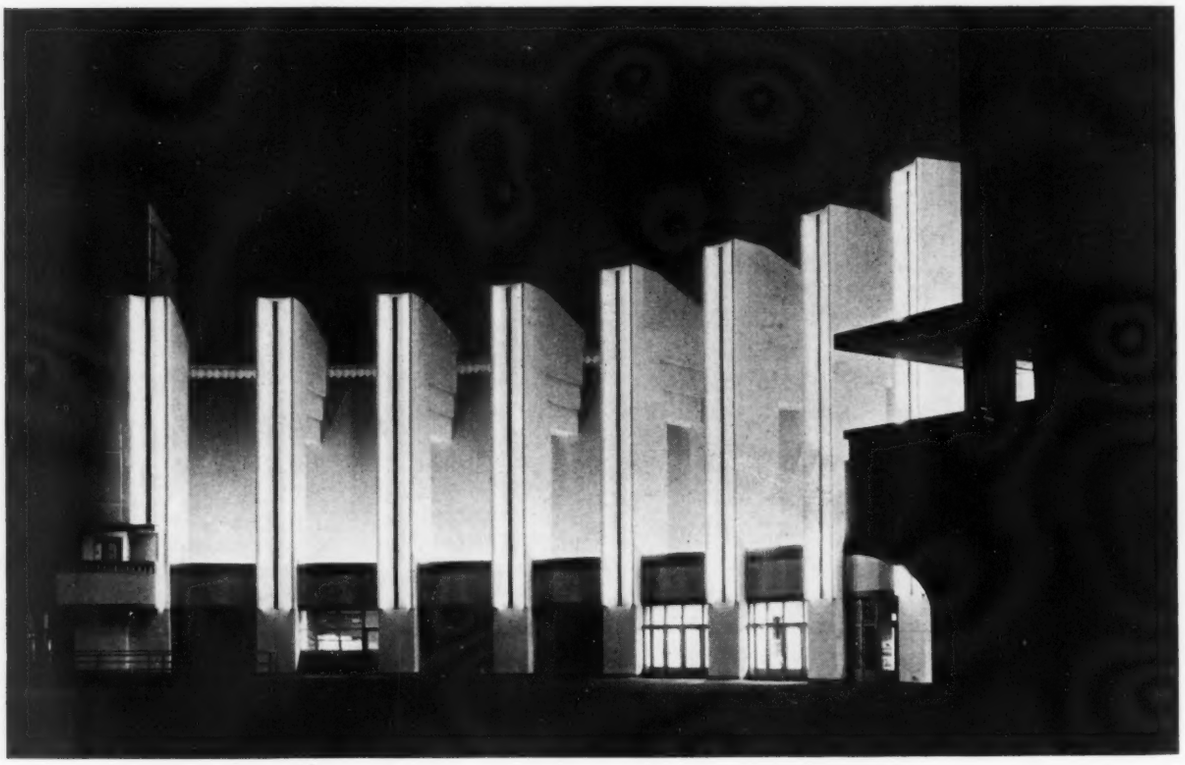
Lighting an Exposition

water spouted 80 ft. in the air, requires a period of ten minutes.

Unusual gaseous tube lighting used

New developments in gaseous tube lighting provide one of the most unusual and certainly the most advanced display of mobile color lighting. Hot-cathode neon and mercury-vapor tubes are set alternately in the fins of a louvered pylon, having a diamond-shaped cross-section and standing 38 ft. high. The underside of each fin is illuminated by the gaseous tube beneath it and the whole display is controlled by a "Thyratron" panel, by which the colors on the pylon are changed almost imperceptibly from greenish yellow through the intermediate shades to neon red. With the changes in light in this display colors on the walls in the first court of the general exhibits group, where the pylon is located, are completely changed through a wide range of hues. Forty-eight hot-cathode neon tubes and the same number of mercury-vapor tubes are used in this feature.

The exterior illumination of the buildings constructed by A Century of Progress exposition was undertaken jointly by the General Electric Company and the Westinghouse Electric & Manufacturing Company, engineers from both organizations collaborating in the design and execution of the scheme. The installation of the lighting equipment and the design and installation of the entire electrical distribution system were under the supervision of J. L. McConnell, electrical and mechanical engineer of the exposition. The illumination of several buildings erected by concessionnaires and exhibitors represents many interesting contributions of individual engineers and lighting organizations.



Electricity for the World's Fair

By J. L. McCONNELL
Chief Mechanical Engineer A Century of Progress

TO put in a 36,000-kw. electric service installation that will have an operating life of only five months is a different kind of job from that which is usually handed to the engineer. In only one imperative consideration is the electrical installation in A Century of Progress directly comparable to ordinary engineering work. It had to be made safe. Obviously, no other consideration could be allowed to detract in the slightest degree from safety. Therefore, in the design and planning of the entire installation first and paramount has been the thought of safety, which, of course, includes reliability of service. That thought accepted, no regard for precedent or previous practice has been allowed to interfere with the consideration and study of new ideas and with their adoption if they appeared worthy. The design of the electrical installation, therefore, is filled with numerous things that have never been done before and some of them perhaps might outrage the professional susceptibilities of hidebound engineers who are resentful of new ideas. Rather than attempt to catalog the various departures from accepted practice which are included in the exposition job, let us rather treat them as they appear in a straight-line description of the electrical installation from the point of energy supply to the final light or power outlet.

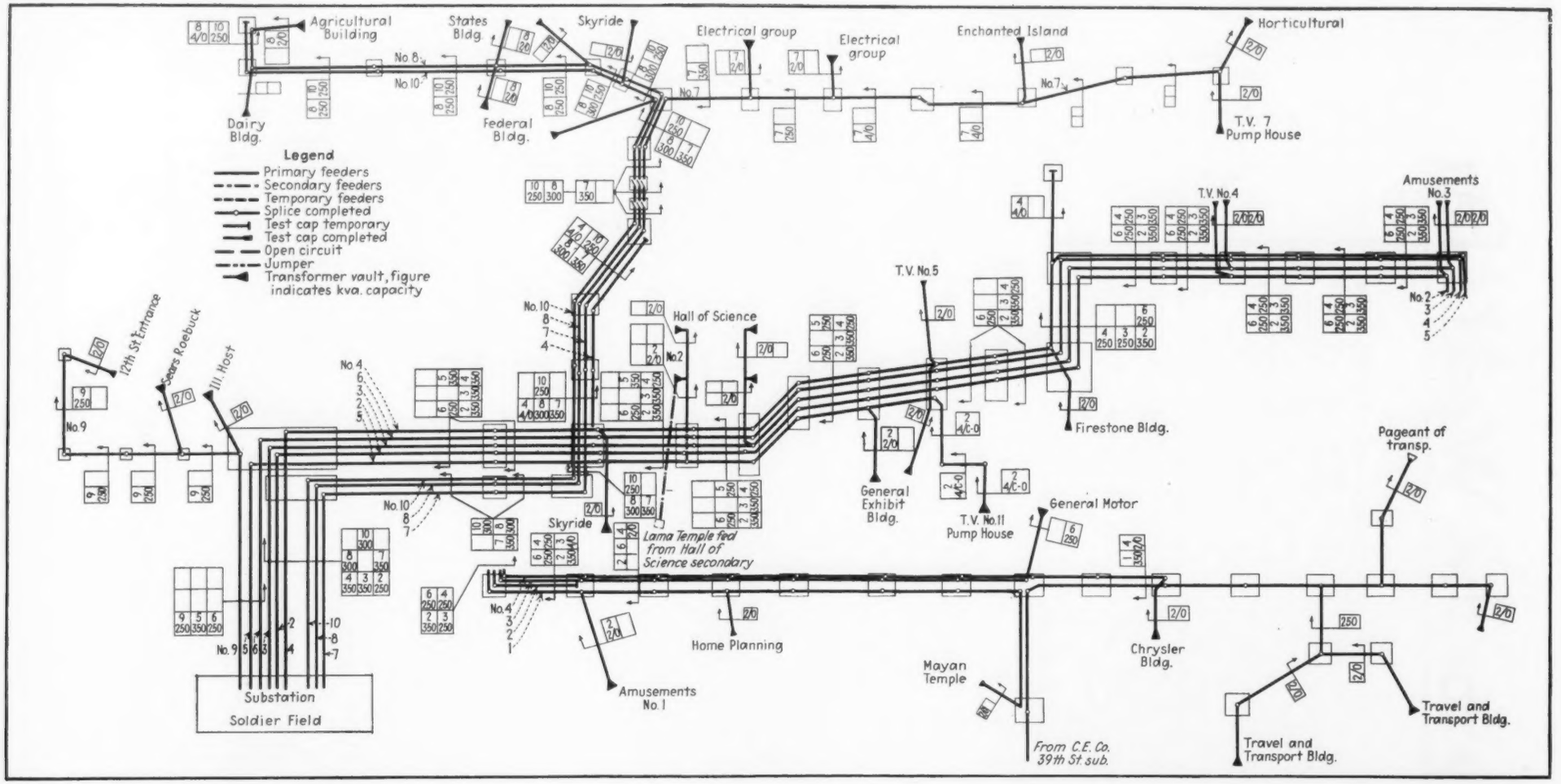
Electricity for the fair is purchased from the Commonwealth Edison Company. The greater part of the exposition area is served from a substation in the Soldier Field stadium structure, to which two 12-kv. lines are run from the Edison system. The substation contains six transformers of 30,000 kva. capacity total. From this point are taken nine 4,000-volt, three-wire Y feeders carried underground to the transformer vaults in the fair buildings. A tenth 4,000-volt feeder, supplying the fair area south of 31st Street, the Travel and Transport building and associated exhibits, comes direct from the 39th Street substation of the utility company.

The underground system is in 4-in. uncreosoted wood pump log conduits. These are laid about 20 in. below the surface of the ground, without any concrete envelope or other holding or protective means. The largest runs consist of nine ducts, the square conduits simply laid on each other in three rows. Care is taken that the duct runs lay mostly in uncovered areas, under lawns, for example, where sprinkling will keep the soil moist and assist in heat dissipation. Distances between manholes vary from 400 to 600 ft. The principal economy of this type of underground construction lies in the elimination of concrete, a saving of at least 50 per cent. Manholes are made of wood planks, except those under roadways, where traffic will be heavy and which are of concrete. There will be no salvage of the duct system when the fair is over. The pump logs will simply be left in the ground and the manholes filled in.

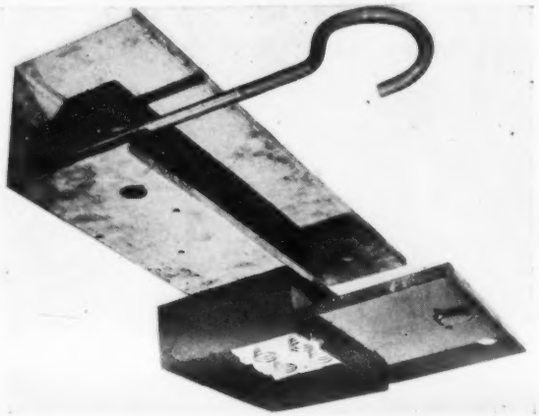
The 4,000-volt feeders are 350,000 and 250,000 circ.mil., Nos. 4/0 and 2/0 in size. All are three-conductor, paper-insulated, lead-covered, with the lead sheath used for the neutral return. The total amount of cable installed is 140,000 ft. None of this cable was purchased, all being rented from the Commonwealth Edison Company, which will take it back when the fair is over.

All of the four-wire, 120/208-volt Y secondaries are underground, mostly in pump log conduit, except for those feeders whose complete lengths are contained in the larger buildings. The underground secondaries are RILC cables standardized at No. 4/0 for the phase wires with No. 2/0 RIDB for neutral. The secondary feeders in the buildings are RIDB, No. 2/0 standard. In order to keep track of the secondary systems and to have available a record for clear and instant reference in cases of trouble all of the secondary feeders are identified with code letters and numbers. Thus, if trouble occurs at any point, a glance at the record map of the particular area will show the affected part immediately. The necessity for such a comprehensive system of identification is apparent from the reproduction of the layout which accompanies this article of one of the simpler areas. Service connections from underground secondaries are made with unfused safety switches.

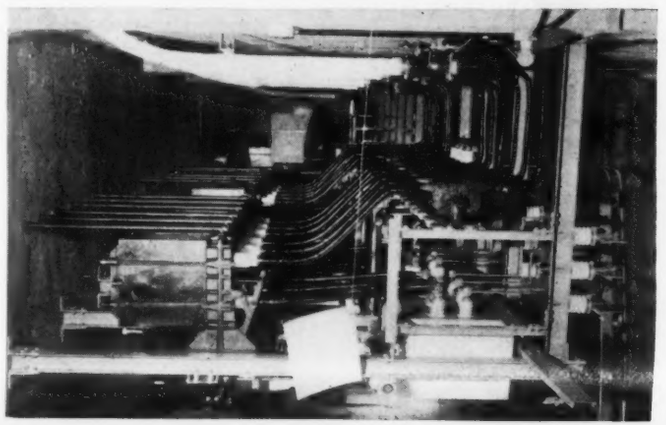
In the effort to keep costs as low as possible, the very simplest layout of transformer vaults is used. How effectively that purpose was attained is instanced by the fact that transformer installations were made in the vaults at labor costs of $160 for a 150-kva. bank and $180 for a 200-kva., with labor at the Chicago union scale. The vaults



LAYOUT OF PRIMARY FEEDERS FOR THE CENTURY OF PROGRESS

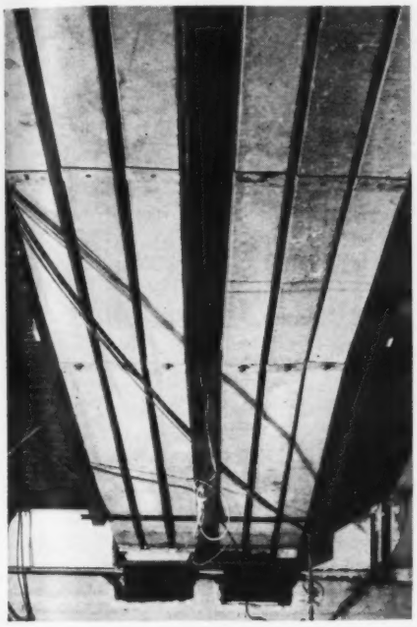


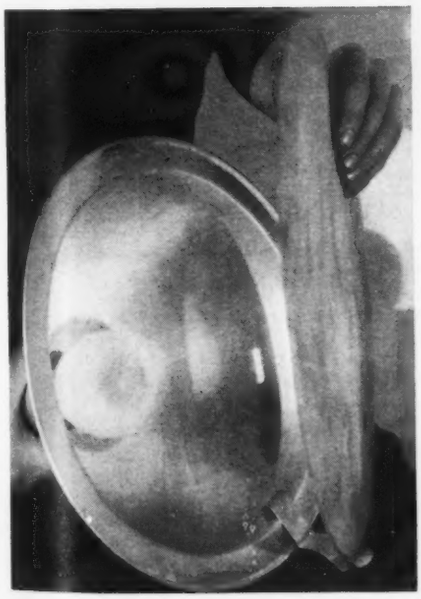
The raceway idea—The feeder cables are laid in the trough on both sides of the hook bolt hangers in horizontal layers of four each with asbestos separators between. Circuits are taken off where required from branch boxes bolted to the side of the trough.



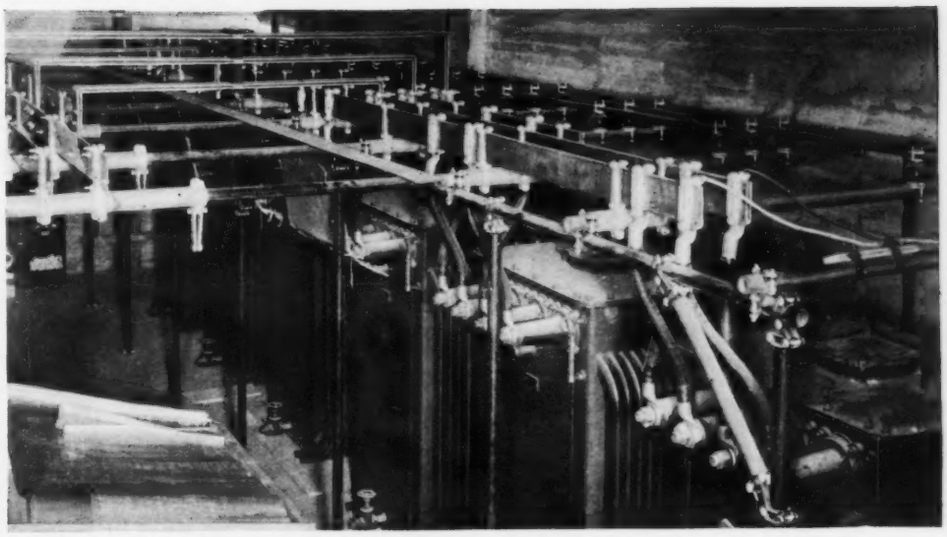
Soldier Field substation—This substation will bear close inspection as an instance of electrical construction that contains no frills, yet includes all the elements of safe and reliable design at an extremely low cost.

Feeder troughs—This construction picture shows six raceways that may, and probably do, carry 96 No. 2/0 feeder cables away from the transformer vault on the other side of the concrete wall.

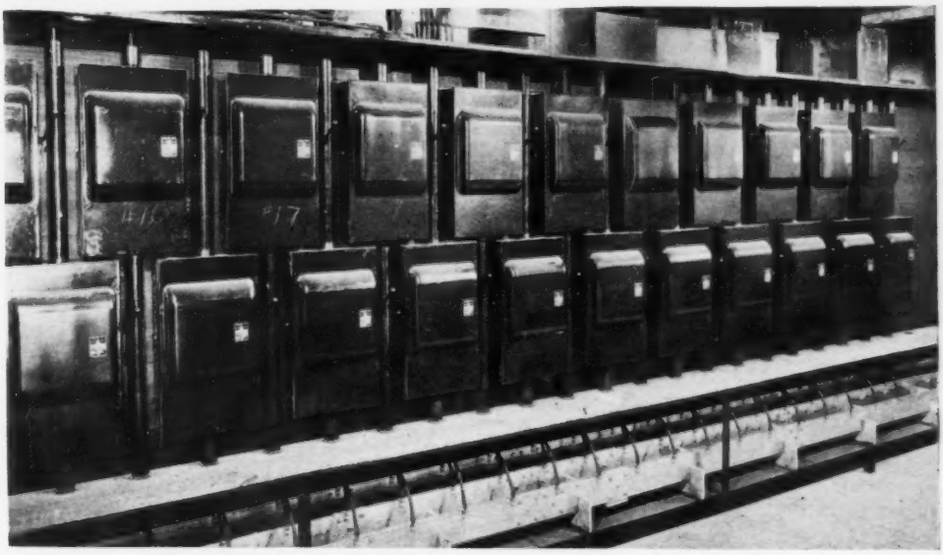




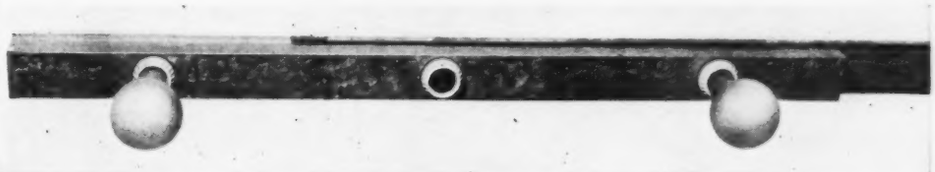
Standard lighting unit—General interior lighting is accomplished with standard units of this type. Each contains a 200-watt lamp. The units are set flush in the ceiling with three projecting clips to hold the ground glass plate about an inch below the ceiling plane. Color screens may easily be inserted where needed. These units, not including lamps, cost 49 cents apiece.



Bus work in transformer vault—Note fiber tubes on pipe rack to insulate secondary bus.



A feeder board—At the top is the neutral bus from which solid taps are taken. The switches, tapped from the phase buses at the bottom, are safety type standardized at 200 amp. capacity.



Preassembled for strip lighting—With sign sockets at 1-ft. intervals, in 10-ft. assembly lengths, about 150,000 ft. of this raceway is used both inside and outside the exposition buildings.

Electricity for the World's Fair

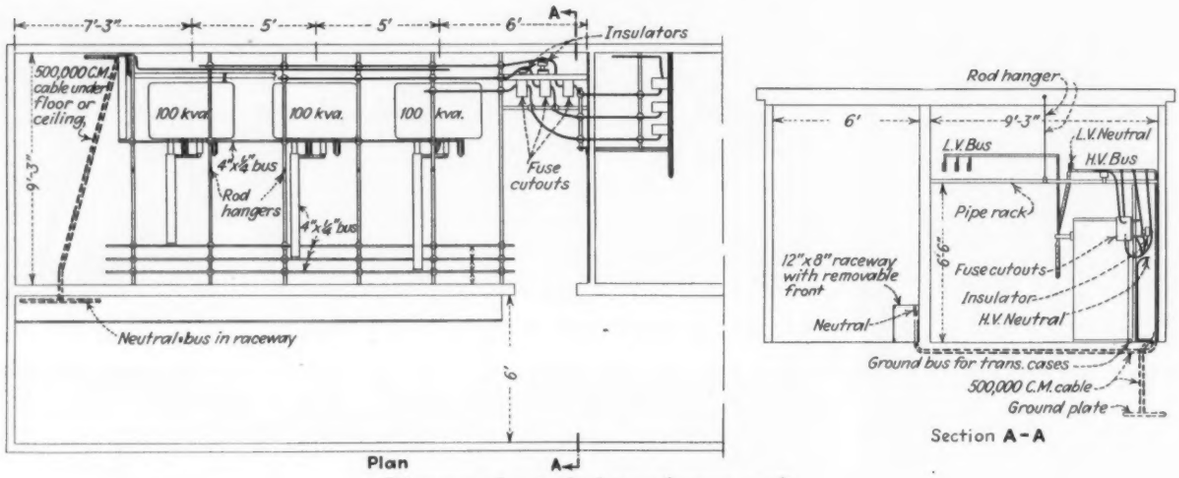
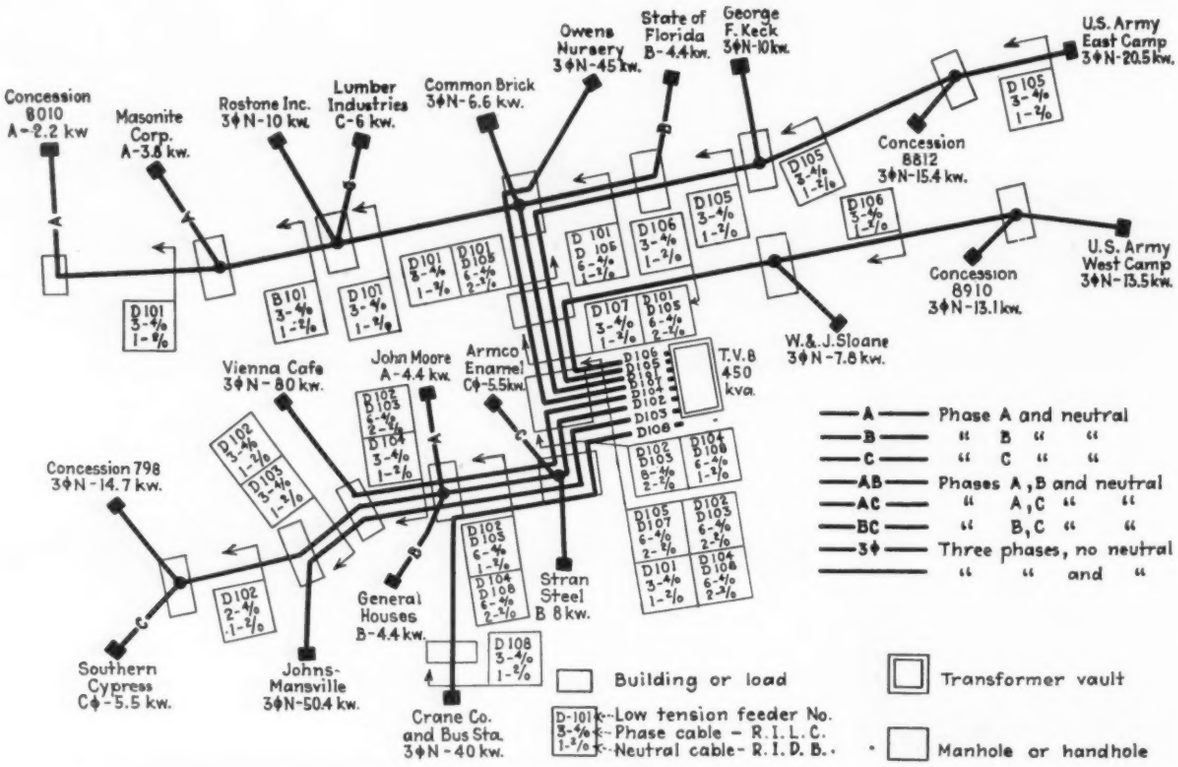


Diagram of a typical transformer vault


Concession 8010 A-2.2 kw
Masonite Corp. A-3.8 kw.
Rostone Inc. 3ϕN-10 kw.
Lumber Industries C-6 kw.
Common Brick 3ϕN-6.6 kw.
Owens Nursery 3ϕN-45 kw.
State of Florida B-4.4 kw.
George F. Keck 3ϕN-10 kw.
U.S. Army East Camp 3ϕN-20.5 kw.
Concession 8812 3ϕN-15.4 kw.
Concession 8910 3ϕN-13.1 kw.
U.S. Army West Camp 3ϕN-13.5 kw.
W. & J. Sloane 3ϕN-7.8 kw.
T.V.B 450 kva.
Armco Enamel Cϕ-5.5 kw.
John Moore A-4.4 kw.
Vienna Cafe 3ϕN-80 kw.
Concession 798 3ϕN-14.7 kw.
Stran Steel B 8 kw.
General Houses B-4.4 kw.
Southern Cypress Cϕ-5.5 kw.
Johns-Mansville 3ϕN-50.4 kw.
Crane Co. and Bus Sta. 3ϕN-40 kw.
A — Phase A and neutral
B — " B " "
C — " C " "
AB — Phases A, B and neutral
AC — " A, C " "
BC — " B, C " "
3ϕ — Three phases, no neutral
" " and "
Building or load
Transformer vault
D-101 3-4/0 1-2/0 — Low tension feeder No. — Phase cable - R.I.L.C. — Neutral cable - R.I.D.B.
Manhole or handhole

Secondary cable method—No overhead distribution on the fair grounds; all secondaries, except in buildings, are underground. Phase wires are in single-conductor, lead-covered cables with the neutral a separate rubber insulated double-braid conductor. Secondary is 120-208-volt Y. This layout of one of the simpler distribution areas shows the means of feeder identification. In this particular area all of the cables are in ducts, but single lead-covered cables are also simply laid in the earth.

Electricity for the World's Fair

contain no oil circuit breakers, disconnecting switches or metering equipment. The 4,000-volt feed simply fans out from a pothead to disconnecting type fuses mounted on the end of the pipe rack which extends over the transformers to support the primary and secondary buses. The primary buses are of rubber-insulated cable, but the secondary are bare copper bars. At points where the secondary bus is supported on the pipe rack insulation is provided by short lengths of fiber tubing slipped over the pipe. From the transformers the secondary bus is carried solidly to a distribution bus, from which the feeders are taken off by means of fused safety switches. The standardization of feeder sizes at No. 4/0 for underground and No. 2/0 for interior allowed the standardization of safety switches at 200 amp. capacity, with consequent savings in purchasing. At the top or bottom of each secondary switchboard is a metal distribution cabinet containing the neutral bus, from which solid taps are taken for all of the feeder neutrals.

Feeders are divided into six groups, which are separately switched: Interior lighting, emergency lighting, exterior lighting, power, show windows and concessions.

Feeders in the main building are carried in a system of metallic raceways, which does away entirely with the necessity for central distribution points or cabinets from which circuits are fed off. This new system, developed by the electrical division of the exposition, is being used for the first time anywhere in the fair buildings and it costs only one-eighth as much as the usual conduit installation. The 5x5-in. raceways are installed in 10-ft. lengths. As many as sixteen No. 2/0 cables with 3/16-in. asbestos separators between layers of four can be laid in a single raceway which is supported by a series of hook bolts in the center so that the wires can be laid on both sides of it. Fuse boxes of four-circuit capacity are secured to the raceway every few feet, reducing the wiring in the circuit system to less than 30 per cent of the amount that would be required under ordinary methods. Where three-phase service is required three fuse boxes are located together.

The raceways are constructed of 18-gage galvanized metal with 22-gage snap-on covers. The fuse boxes are of 19-gage steel. It is estimated that more than 70,000 ft. of the 5-in. raceway is contained in the main feeder systems throughout the fair buildings. Inspectors who have tested the wiring system have pronounced it to be the safest that has ever been provided for any exposition.

Practically all of the conductors for feeders are No. 2/0, as stated. The circuit conductors are No. 12 wire. A significant item in economy of labor cost in connection with the feeders is that the feeders were specified to have a thin paper tape wound round the copper to separate it from the rubber insulation. This detail saved a lot of time and labor that would have been expended in scraping out rubber imbedded between cable strands and insured a bright, clean area of copper where the feeder insulation is cut off to make a circuit tap. Soldered joints are used.

Another detail that made for speed and labor economy was the use of a wire stripper in place of the traditional electrician's jack-knife to cut insulation off the No. 12 circuit wire. This tool, handled like a pair of pliers, takes off one inch of insulation at a cut. The secondary wiring for

Transformer Capacities at Load Centers, 4,000-Volt Y/120-208-Volt Y

Transformer Vault	Kva. Capacity
Agricultural Building	600
Dairy Building	225
States Building (2 vaults)	1,200
U. S. Government Building (2 vaults)	900
Sky Ride—East Tower	1,000
Sky Ride—West Tower	1,000
Electrical Group (2 vaults)	2,100
Enchanted Island	300
Horticultural Building	225
Pump House (TV7)	225
12th St. Gate	450
Sears-Roebuck Building	600
Illinois Host Building	75
Hall of Science (4 vaults)	2,850
General Exhibits Building (2 vaults)	1,800
Pump House (TV11)	225
Firestone Building	500
General Service (TV5)	450
General Service (TV4)	900
Amusement area No. 3 (2 vaults)	900
Amusement area No. 1	750
Home Planning Building	450
General Motors Building	2,400
Mayan Temple	225
Chrysler Building	750
Pageant of Transportation	450
Travel and Transport Building (2 vaults)	1,800
General Service (TV10)	450
Hollywood	450
Lagoon Fountains	450
Bathing Beach	300
Total capacity	25,000

Total vaults, 41.

the general interior lighting is done with cleats. Before delivery to the field, the cleats were assembled in pairs with a U-bolt, under the yoke of which is a flat piece of metal having ears that are bent up over the flanges of building steel to hold the cleats in place. For signs and for strip lighting, both interior and exterior, circuit wiring was preassembled in 10-ft. lengths of metallic raceway of 26-gage sheet metal. Each 10-ft. length is punched for sign type sockets, spaced 1 ft. apart. This raceway was installed at a minimum cost, being secured by nails or screws. The cost installed is about one-third to one-fourth of any other type. About 150,000 ft. of this raceway is used in the various buildings.

All buildings are provided with emergency lighting by a system entirely separated from the regular lighting system. The emergency circuits are provided with batteries and chargers and automatic throw-over switches as they are normally energized from the regular supply. Changeover from normal to emergency supply is automatic. As an added measure of safety, the wiring for emergency lights located in corridors and stairs is installed in conduits throughout.

There are no special circuits for outdoor lighting except in the instance of Leif Erickson Drive, which is a city boulevard. That part of the drive within the fair grounds is equipped with a lighting system of the standard park design. It was necessary only to meter the circuits separately in their transformer vaults and to decorate or alter the lighting standards to meet the requirements of the system. All other exterior lighting will be on special poles fed by 120/208-volt circuits from the nearest building. The circuits to the lighting standards are installed by plowing in lead-covered single-conductor cables about 1 ft. below the surface of the ground. The lighting loads are balanced on three-phase circuits, each phase conductor having a distinctive identifying color, A phase, yellow; B, red; C, white, and the neutral unmarked. The loads on these circuits run up to 80 kw., for which No. 4/0 conductor is used. A large amount of No. 12 cable is used to feed the 500 "mushroom" lights scattered about the grounds. The amount of cable so installed for general lighting totals about 150,000 ft.

Electricity is supplied to exhibitors and concessionaires on either a flat or metered rate as is desired. If the user wants to buy through a meter he pays the cost of the meter and its installation. The meter rate for energy to exhibitors is the same as that on which the fair buys from the Commonwealth Edison Company, except that 0.5 cent is added for each of the first 2,000 kw.-hr. to pay for meter reading and billing. Each meter has a maximum demand attachment. The rate is $1.40 per kilowatt for the first 25 kw. of demand plus $0.75 per kilowatt for excess plus 3½ cents per kilowatt-hour for next 3,000 kw.-hr. and grading down in steps to 0.65 cent per kilowatt-hour for excess over 100,000. This is stated to be the lowest rate for electricity offered by any exposition.

A distinct element of economy in the whole electrical installation was the assembly of distribution and circuit units in the shop previous to installation. This preassembly and preshaping of devices and materials was done either by the suppliers or in shops on the ground. Field labor was thus employed essentially in installation and little time was used in assembling and cutting and fitting on the job.